FEB 1993

THE INDIAN FORESTER

(FOUNDED IN 1875)

ECO DEVELOPMENT PROJECT
AT KENDBONA Ps-PUNCHA
Dist- PURULIA
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VOL. 118 DECEMBER 1992 NO. 12

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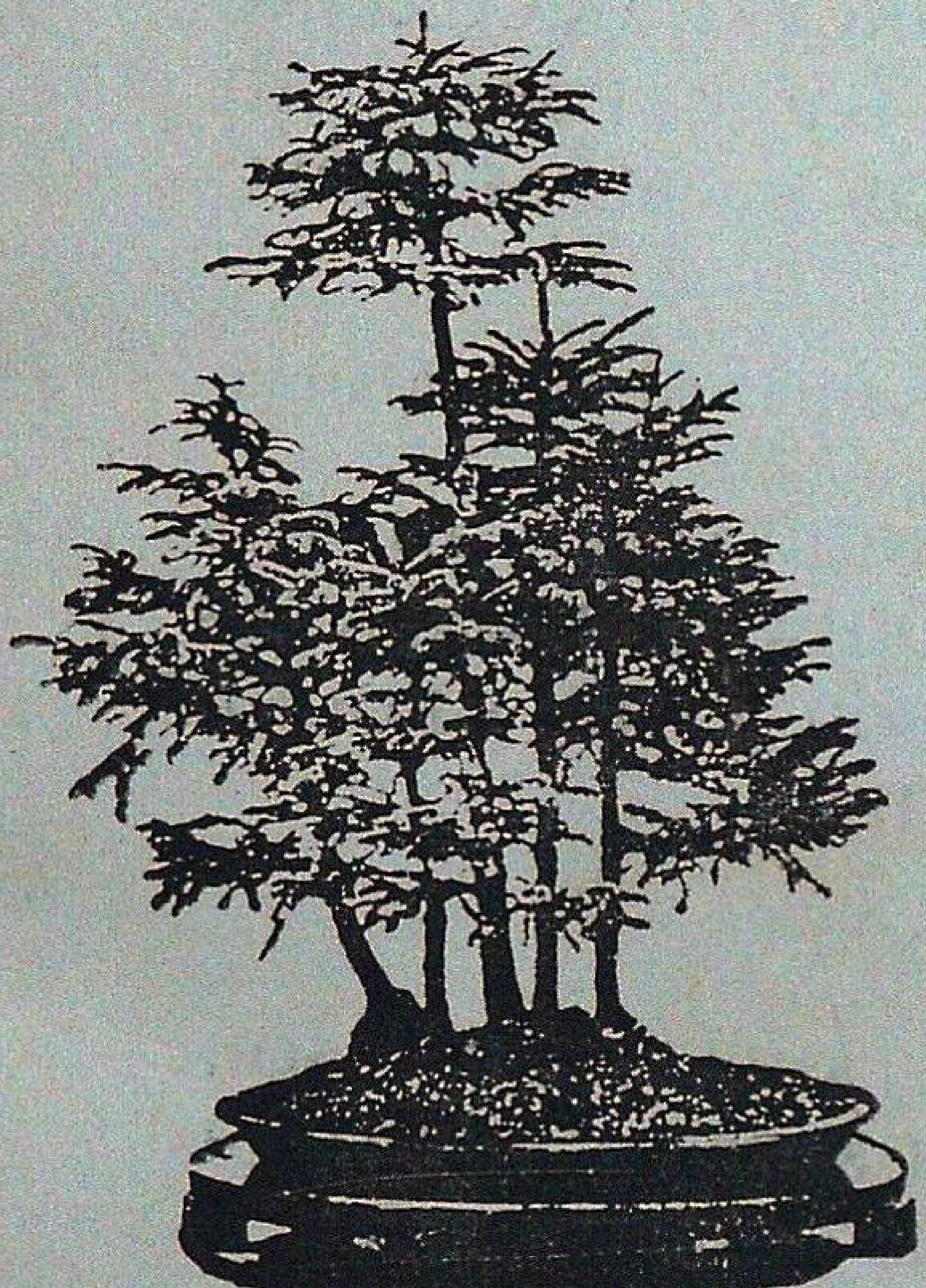

FRONT COVER

BENEFICIARIES AT WORK IN KENDBONA ECO-DEVELOPMENT PROJECT, DISTRICT PURULIA, WEST BENGAL.

(Details on page 879)

Photo—M.K. Chowdhury

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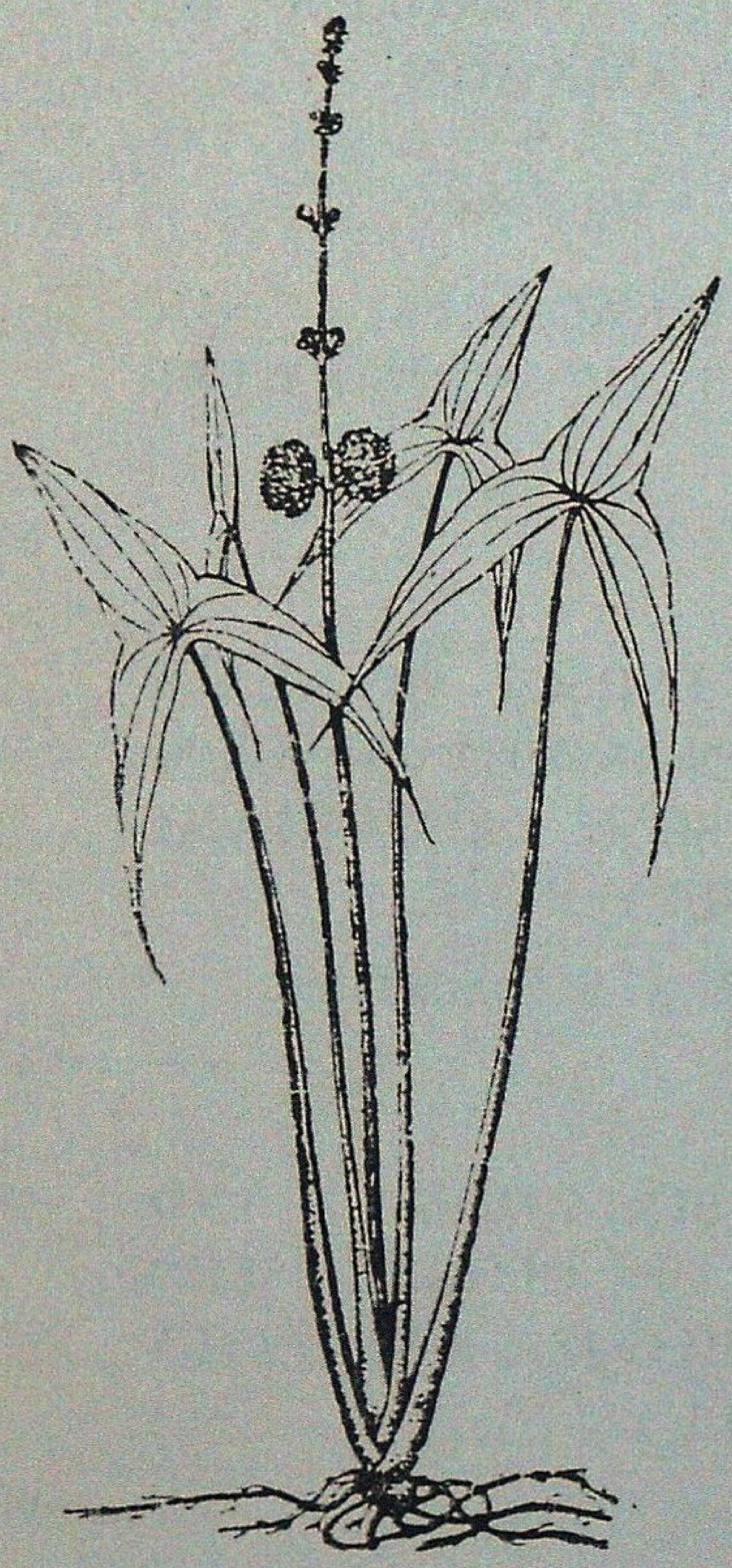

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VOLUME 118 NUMBER 12

THE
INDIAN FORESTER
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EDITORIAL

We have the pleasure of announcing the *Brandis*, *Schlich* and *S.K. Seth Memorial* Prizes for the year 1991 to the following recipients to whom we offer our heartiest congratulations :

Names of the Authors.	Article	Prize money
	Brandis Prize	
S/Shri V.N. Tandon, M.C. Pandey, H.S. Rawat and D.C. Sharma.	Organic productivity and mineral cycling in plantation of *P. deltoides* in Tarai Region of U.P. (Pub. in August '91 issue)	Rs 300/-
S/Shri K.K. Jha and Chandra Gupta	Intercropping of medicinal plants with Poplar and their phenology (Pub. in July '91 issue)	Rs. 300/-
Shri V.R. Singh	Use of intensive soil working technique in afforestation of wastelands (Pub. in July '91 issue)	Rs. 300/-
Shri A.K. Upadhyaya	Shelterbelt plantations effectively check siltation in Indira Gandhi Canal (Pub. in July '91 issue)	Rs. 300/-
Shri Dhananjai Mohan	Cover Photo (October '91 issue)	Rs. 100/-
	Schlich Prize	
Shri D.N. Tewari	Shifting cultivation in India (Pub. in Feb '91 issue)	Rs. 100/-
	S.K. Seth Memorial Prize	
Shri A.K. Mukerji	Causes for ecological degradation in Himachal Pradesh–Need for rehabilitation (Pub. in June '91 issue)	Rs. 300/-
Shri P.K. Roy Choudhuri	Biomass production of mangrove plantation in Sundarbans, West Bengal (India)–A case study (Pub. in Jan '91 issue)	Rs. 300/-

Pankaj Khullar
Hony. Editor.

KENDBONA ECO-DEVELOPMENT PROJECT – A NOVEL APPROACH TO WASTELAND RECLAMATION

M.K. CHOWDHURY*

Introduction

Reclamation of wasteland unfit for agriculture, by afforestation is a declared policy of the Government. While afforestation of blank, degraded land, wasteland within the demarcated forest land has been one of the routine activities of the State Government, the wastelands outside are under continuous degradation for lack of any concerted efforts to put them under tree cover. The social forestry activities in the decade of the eighties addressed the problem to some extent when some wastelands outside the demarcated forest lands were afforested. The National Wasteland Development Bank subsequently took initiative in the matter and a number of schemes for afforestation of wastelands have been framed and are being implemented, some carrying provisions for margin money assistance. Some of the Forest Corporations, which were earlier set up for production forestry purposes, have also switched on to wasteland development projects, especially after large-scale commercial forestry became redundant due to the National Forest Policy 1988, for which these Corporations were incorporated in the first place. After its activities in the North Bengal forests became severely restricted the West Bengal Forest Development Corporation started spreading its activities in South West Bengal where there was previously none. One of such projects was the Kendbona Eco-development Project in Purulia District, which centers round the development of about 54 ha of wasteland, through a variety of plantation models, aiming at an ecological and economical rehabilitation of the largest population in the immediate vicinity of the project area.

The Project

Area and Locality factors : In Kendbona Project, the land occurs in six patches, interspersed amidst villages and cultivation. The locality factors are typical of the eastern extension of the Chotanagpur plateau, with a long summer and short winter, both intense. The monsoon is usually spread over 3-4 months from June to September. The annual precipitation varies from 1000 mm to 1500 mm. The summer temperature hovers between 42°C to 45°C and in winter, the mercury settles between 9°C to 14°C. The soil is red lateritic, mostly in the nature of sandy loam with pockets of clayey loam.

Before the land was taken up under the project, there was no specific land use demand, though most of the time the area was used as a common grazing ground for the village cattle. Except for a few inferior grass and weeds, the area was barren with signs of sheet and rill-erosion manifest everywhere. (Plate 1)

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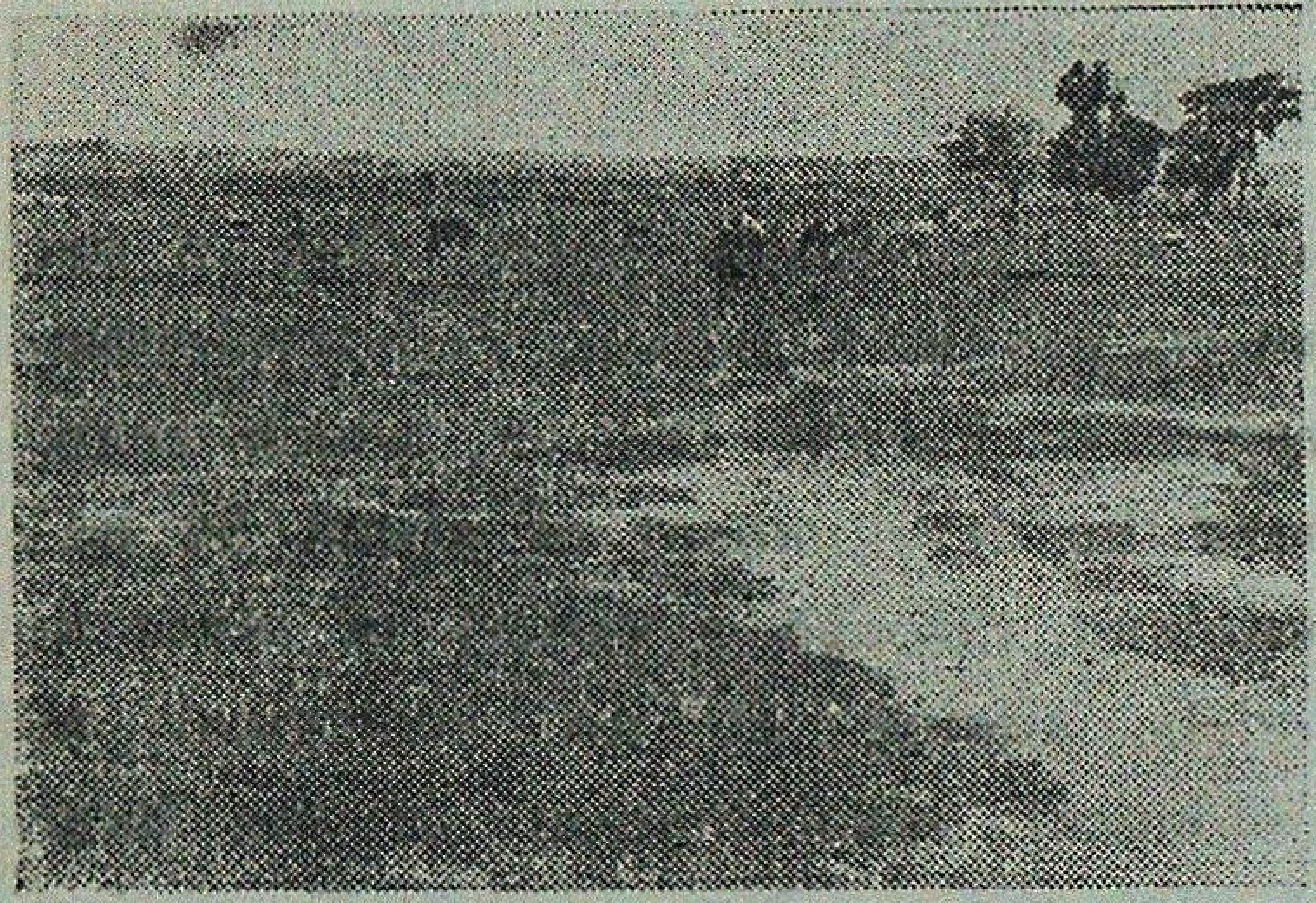
* Chief Conservator of Forests (Territorial), West Bengal, Calcutta.

Plate 1



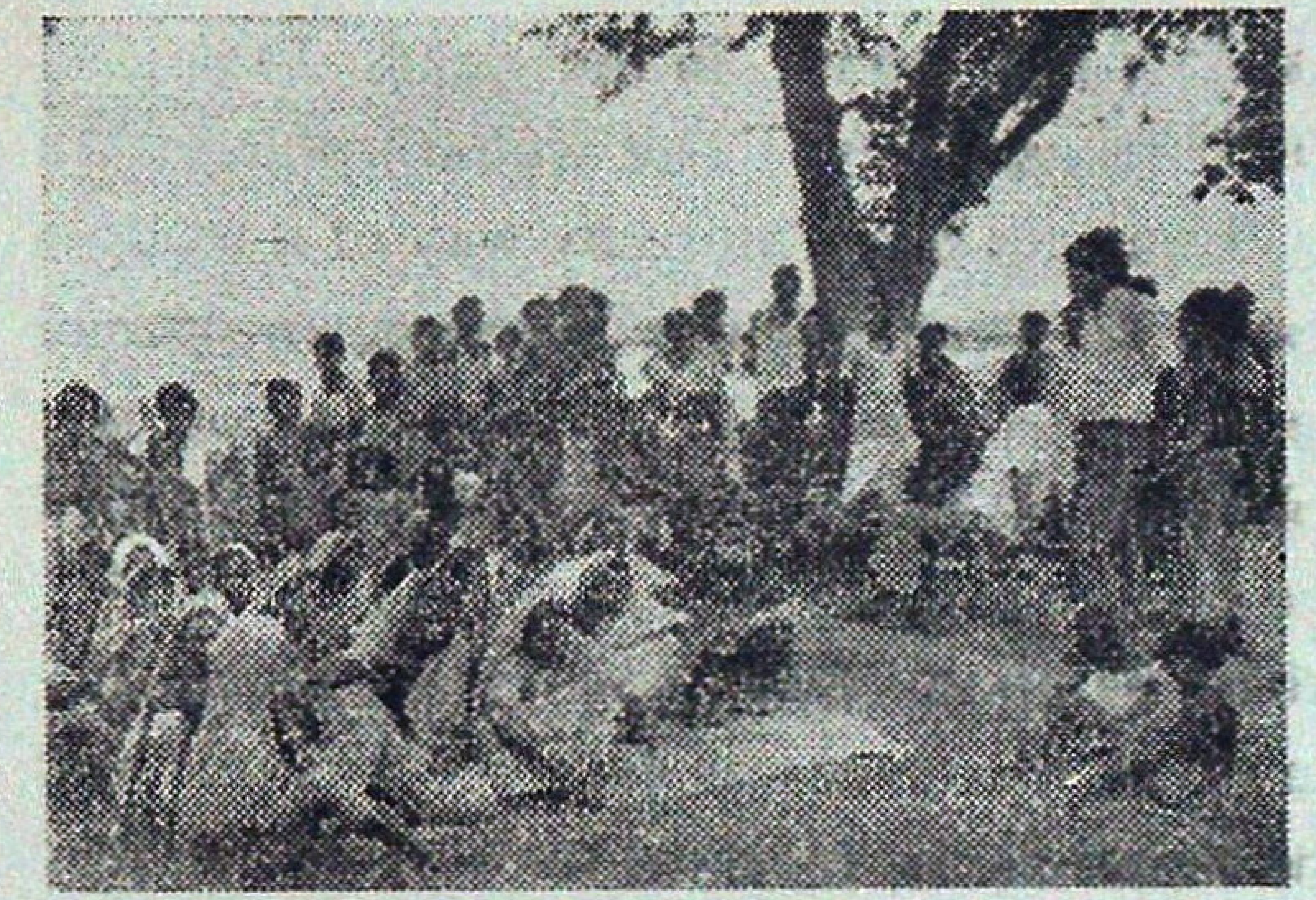
The degraded wasteland before the same was taking up for development under the project.

Demography : At the time the pre-project survey was undertaken in 1988, the Kendbona village had 48 families, of which 13 families belonged to scheduled castes and 35 to scheduled tribes. The sex break-up for the scheduled castes population was, 47 males and 54 females, i.e. a M/F ratio of 1:1.2 and for the scheduled tribes the same was 98 males and 108 females, with a M/F ratio of 1:1.1. The average family size for the scheduled caste population was 7.7 persons, while that for the scheduled tribe population was 5.9 persons. The land holding pattern was that, 30 families had land over 0.4 ha each, 15 families had a holding below 0.4 ha each (of which 3 families had no agricultural land). The total livestock population in the village was 225. The economic condition of the villagers, especially the landless and those with holdings below 0.4 ha per family, was below the poverty line. Agriculture was rain-fed and only monocrop. Due to limited agricultural activities, the lean period unemployment is high and seasonal labour migration was a common feature.

Project planning and selection of particulars : After a preliminary survey, discussions were held with the villagers and the Chirudih Gram Panchayat under which the village belonged regarding the approach and methodology of development, so that a generally acceptable package of schemes can be evolved. Since the project was based on the principle of participatory management between the West Bengal Forest Development Corporation and the local people, from whom the actual beneficiaries were to be identified, the discussions were important for involving ground-support to the eco-development project.

The beneficiaries were selected with the help of the Chirudih Gram Panchayat and 21 families with no land or very small parcel of agricultural holding around 0.4 ha, were chosen (Plate 2). One of the unique features of the project was that the 21 beneficiaries, who were finally listed from the identified families, were all women. This was considered desirable because it was thought that the women of the village should be assigned due role in a project that had societal good, like environmental amelioration, environmental maintenance and economic uplift as its objective. Combined with this idea was the presumption, that the women would be zealous to protect and preserve the assets that would bestow some economic benefits to their families in general and to themselves in particular, leading to a feeling of emancipation from the economic servitude that the women in a male-dominated

Plate 2



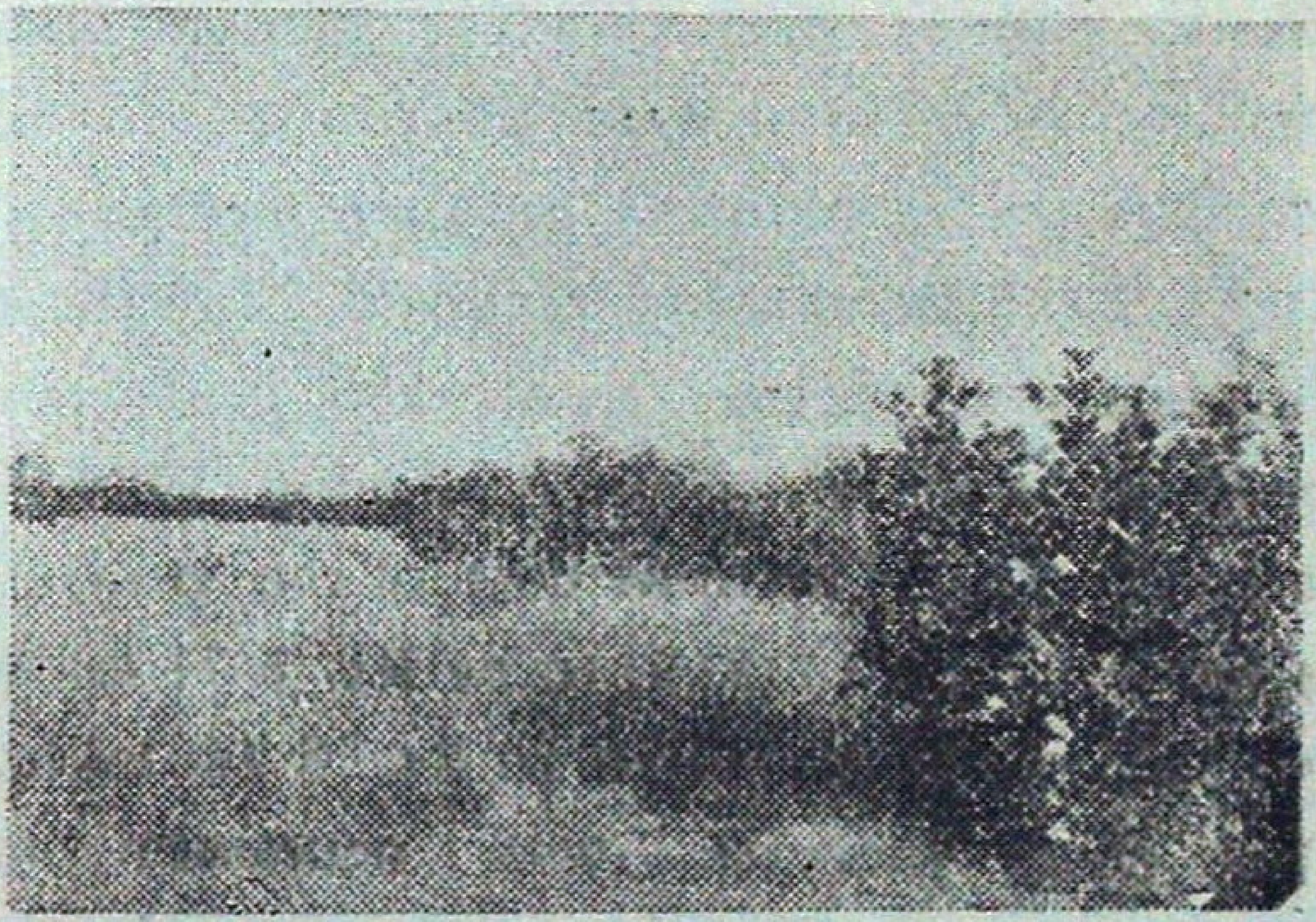
Discussion between the W.B:F.D.C. officials and the participant beneficiaries

village society are traditionally subject to. As most of the afforestation project, where popular involvement is sought for implementation and success, usually veer round the male member of the rural society, induction of women was thought to be a novel experimentation to assess the difference, both qualitative and quantitative that might ensure in planning and implementation of the eco-development project (see Front Cover).

Plantation models : Since the main objective was to cover the wasteland with a simultaneous or a quick return of benefits to the individual beneficiaries, plantation models with quick growing or early yielding species were chosen. Moreover, even the quick growing species have a minimum gestation period of 7-8 years and this, though reckoned as "short-rotation" in the conventional time-frame for forestry, was a hiatus long enough for the impoverished beneficiaries to wait. Therefore, intercultivation was adopted, so that yield begins from the 2nd or 3rd year. Three plantation models were adopted for the project which are briefly mentioned in the description below :

(a) *Cashew plantation with intercropping of Sabai (Eulaliopsis binata) grass* : This plantation was raised over 34 ha. The planting pattern for cashew was 10m×10m. In the intervening space, sabai grass were planted at a close spacing of 45 cm×45 cm. 17 ha were planted up in 1989 under this model and the balance was raised in 1990. The Cashew *Anacardium occidentale* seedlings were grown from the seeds obtained from the Corporation's cashew plantation Midnapore District, raised earlier from seeds suitable for lateritic tracts (Plate 3).

Plate 3



Cashew with intercrop of Sabai grass (2 year old).

(b) *Bamboo plantation* : Bamboo was raised over 10 ha in 1989 and 1990. In 1990, arahar (*Cajanus*) was raised as intercrop over 5 ha of the bamboo plantations so that some intermediate yield could be obtained by utilising the intervening space between the bamboos which were planted at a 7 m × 7 m espacement.

(c) As there were no nearby forests to serve the energy needs of the village, fuelwood plantations were raised over 10 ha in 1989 and 1990 in the form of peripheral rings around the above plantations which were vulnerable to biotic damages like grazing etc. The species raised were *Acacia auriculiformis* and *Eucalyptus*. The spacing was 2.5m×2.5m. Out of the 1500 seedlings planted per ha, 1000 were Akashmoni (*Acacia auriculiformis*), 400 were *Eucalyptus* and 100 were indigenous species, like Karanj (*Pongamia pinnata*) Neem (*Azadirachta indica*) and Mahul.

Apart from these three plantation models by which the entire project area was covered, grafts of mango (*Mangifera indica*), guava, lemon, bael, anona, jamun and seedlings of coconut were distributed to the beneficiaries for planting on their homestead land. Each beneficiary received 28 of these fruit-bearing species. In all 588 grafts and seedlings were distributed during 1989-90 and 1991-92. The total cost of the project, earlier estimated (1989) to be Rs. 6 71 lakhs was subsequently revised to Rs. 8 74 lakhs. This cost increase was necessary as sabai was planted at a denser spacing of 45 cm×45 cm than originally planned and as also as arahar was raised as an intercrop in bamboo plantation which was not orginally provided for. The project is designed to be spread over a span of 6 years from 1989-90 of which the first two were utilised for building up the assets and the ramaining part will mainly involve some maintenance activities and setting up cottage scale facilities for making of sabai grass ropes.

Project benefits : In terms of direct employment to the beneficiaries, the project activities created 7366 man-days in 1989 and 7424 man-days in 1990. The average wage-income per beneficiary was Rs. 520/- and Rs 553/-per month in the years 1989 and 1990 respectively. The sabai, planted in 1989 was cut back, more by way of a tending operation than regular harvest, to induce better growth, in 1990. The cut sabai was sold and the beneficiaries were given 25% of the sale proceeds. Intercropping of arahar with bamboo was not very successful, however, whatever was gathered was sold and the beneficiaries received their predetermined share and the total amount that each beneficiary received from the sale in 1990 was Rs. 135.00.

During 1991, the total income from sale of sabai, was Rs. 83,750.00 and each of the participant beneficiaries received a share of Rs. 1000/- each during the month of September, which is incidentally, the leanest month for the village people (Plate 4). The yield frome sabai will continue to increase reaching its peak around the 7th year after planting, and the area has to be replanted on the 8th or 9th year. The total income from sabai from 1989-90 to 1997-98 is expected to be Rs. 12,74,000/-. The bamboo plantations will start yielding from around the 5th year of planting and continue over a long span of time. However, taking the project management period to be of 9 years i e. co-terminus with the sabai crop. the bamboo is expected to generate as total yield of Rs. 2,75,000/- upto 1997-98. Likewise the yield from cashew, another long yielding crop, is expected to be Rs. 3,46,000.00 upto the same period and that from the fuelwood plantations Rs. 1,80,000.00. Against an investment of Rs. 8.74 lakhs, the expected income from sale of the project products upto

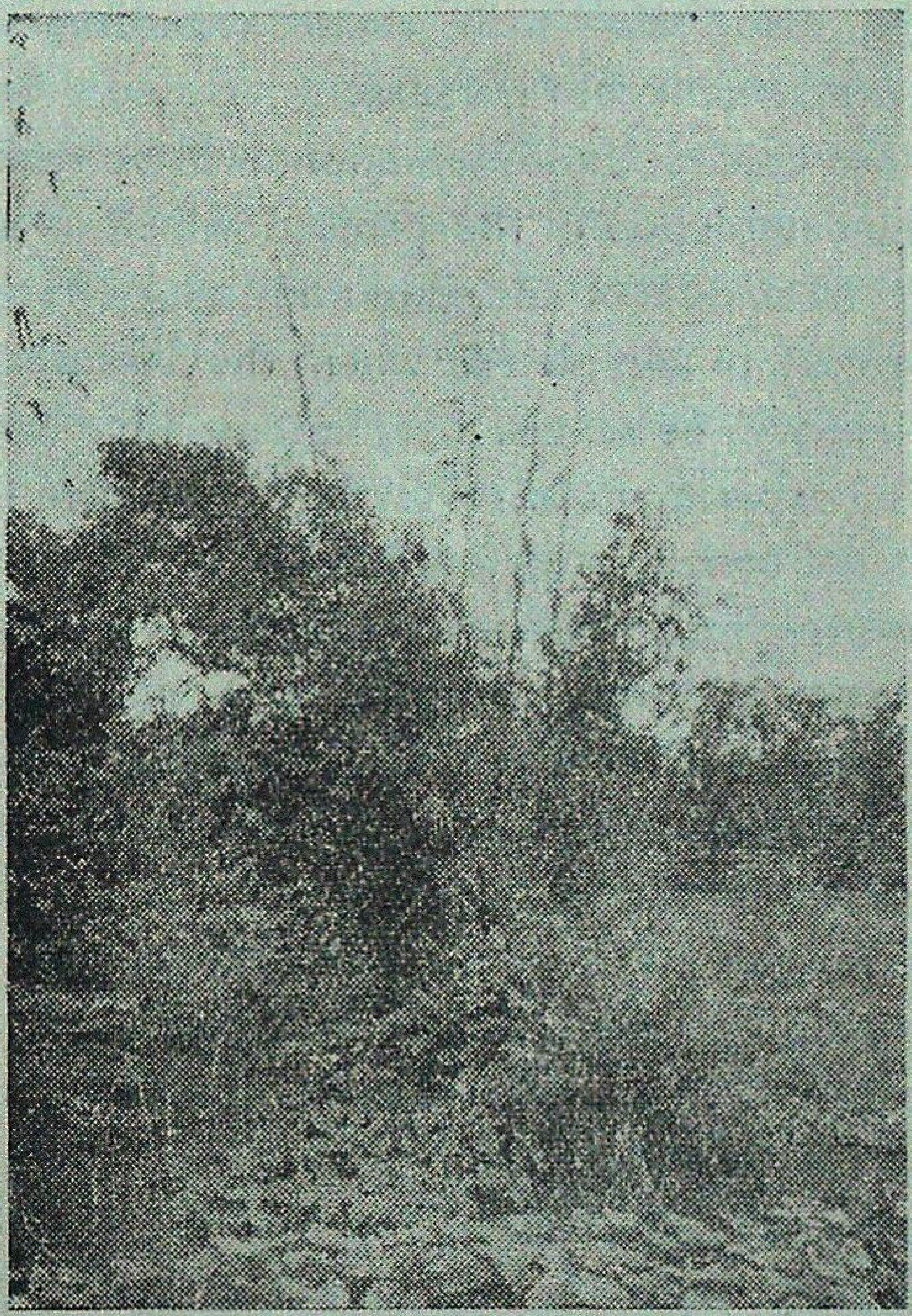
1997-98 will be Rs. 20.75 lakhs. The internal rate of return works out to 14.6% even with a benefit change by '–' 20%, assuming a 14% rate of interest. The expected share of income for the participant beneficiaries out of the total income of Rs. 20.75 lakhs will be nearly Rs. 5.19 lakhs during these nine years, which works out to Rs. 2,750/- per family per year.

Plate 4

Sabai grass being harvested (with the fuel-wood plantation in the background).

The possibility of augmenting the income by value-addition to the plantation product like sabai grass has also been explored. Sabai when made into ropes, fetches a price of Rs. 6/- per kg as against Rs. 2/- per kg for the grass. Hand operated rope making machines, that can be operated by a husband-wife team, have been designed and fabricated and five such machines have been supplied to the beneficiaries who are training themselves up in rope making. Moreover, some of the beneficiaries have also started cultivating vegetables in the interspace between the bamboo, where earlier, arahar was intercropped. Vegetables like sweet gourd, chilli, vindi have been cultivated by fifteen beneficiaries. Inputs like quality seeds, fertilizers have been supplied from the project and the beneficiaries have agreed to pay back the cost of the inputs supplied when they sell the vegetables (Plate 5).

Plate 5



Bamboo with intercrop of vegetable. (Sweet gourd)

Discussions

The sketch presented above depicts a concerted effort by the local people and the West Bengal Forest Development Corporation in evolving an acceptable methodology for wasteland development and environmental rehabilitation. Participation of the people, who are directly tuned to such a programme right from the planning stage, is called for, so that an attitudinal change of the local people to the Government or institutional efforts for common good programmes may result, leading to a positive acceptance of such exercises. In the instant case, the local people and the gram panchayat were involved right from the time of formulation of the plan. Frequent discussions are also held with them regarding the management of the assets created. Such close contact and interactions will be vital to the completion of the project, which is now at the middle of the span and long after the project is completed, when the sustainable yield will be reaped over a long time span. The experiment of involving the women folk as the beneficiaries appears to have yielded positive result and the women have increasingly started sharing the interaction sessions. The income derived so far and that can be earned in the future on a sustained basis, if the assets can be successfully managed, is a total additionality, as the barren wasteland was of zero-income value before before being turned productive. It is worth mentioning in this connection that no provision for Watch and Ward, which is usually done by engaging forest watchers, was made in the project and the participants have been themselves protecting the assets created with the utmost zeal, as has been expected.

Comprehensive approach

The need for linkages that such a programme should have with the overall development strategy, particularly in the forest fringes may be examined. While restoration of wasteland or degraded forest land through active popular involvement, has been found to be a practical proposition, leading to a certain amount of economic gain for the hinterland population, most of the wasteland or degraded forest land will lack the carrying capacity required, even after being so restored, to become the sole economic support-system for the surrounding populace. Unless other measures to improve the economic condition are undertaken, the gains achieved by restoration of wasteland or degraded forest land may soon be negated as increasing economic needs may force the concerned people to resort to resource-mining, leading to eventual destruction of the forests created. It is here that consideration of comprehensive development package, with an area development approach and essentially multi-disciplinary in nature, comes in. Simultaneously or soon after the regenerated wasteland or degraded forest has given an economic foothold to the concerned population, who were earlier forced to a primitive subsistence-gathering economy, programme for development of agriculture, animal husbandry, fishery and other land-based natural production systems, that are ecologically compatible, should be taken up on the villagers' land or village-common areas.

Apart from the area development, works, concerted efforts to uplift the quality of life of the local population is necessary so that a value system, commensurate with the socio-economic regeneration, is built up to sustain and improve upon the gains made through the eco-development works at the initial stages. In the instant case it is also proposed to initiate programmes for total literacy, immunization against the commonly occurring diseases, Integrated Child Development Schemes, family welfare and other similar types of environmental maintenance programmes through the cooperation of the like departments, which will act as strong support for the rural development hinged on wasteland afforestation or forest regeneration programmes.

SUMMARY

Reclamation of wasteland through silviculture has been the declared policy of the country since the mid eighties. Ambitious programmes have been drawn up for afforestation of wasteland both within the demarcated forest land and outside. It is being increasingly realized that peoples' participation in such efforts is most important for such projects to succeed. However, popular involvement can only result if the people, who are essentially poor, can find some immediate and tangible benefit flowing out to them from such projects. Forestry schemes, even when based on short rotation, quick growing species, calls for a minimum gestation period of 5-7 years, which is rather too long for the rural poor to wait. It is here that experimentation in multi-tier forestry is called for, where quick-yielding cash crops like Sabai (*Eulaliopsis binata*), etc. can be grown as a second tier with tree crop. Where permissible, interspace between the tree crop may be utilised to raise agricultural crops that are compatible with the tree crops. Such intercrops will ensure an immediate economic return for the people participating in the afforestation and eco-development project leading to popular involvement and active participation in the effort. This paper describes the success story of a micro-level eco-development project through afforestation and intercropping, with the active participation of beneficiaries, who were all women

बंजर भूमियों के पुनसंस्कार की एक नई दृष्टि—केंदवन परिस्थिति विकास परियोजना

एम०के० चौधरी

साराँश

वन संवर्धन द्वारा बजर भूमियों का पुनसस्कार करना इस देश की नवें दशक के मध्य से ही घोषित नीति रही है। सीमांकित वन भूमि के अन्दर और उससे बाहर दोनों जगह की बजर भूमियों को पुनः सुधारने के लिए बड़े-बड़े महत्वाकांक्षी कार्यक्रम बनाए गए हैं। अब यह बात अधिकाधिक महसूस की जा रही है कि ऐसे प्रयत्नों में परियोजनाओं की सफलता के लिए जनता की भागीदारी मिलना सबसे अधिक महत्वपूर्ण है। किन्तु, जनता को इसमें तभी साथ लिया जा सकता है जब लोग-बाग, जो अनिवार्यतः गरीब हैं, ऐसी परियोजनाओं से तत्काल और आंखों दिखने वाला लाभ प्राप्त कर सकें। वानिकी योजनाओं में, चाहे उन्हें छोटे आवर्तन वाली, शीघ्रवर्धी वृक्ष जातियां लगाने के आधार पर बनाया गया हो, कम से कम 5–7 वर्ष का गर्भकाल अवश्य लग जाता है, जितना समय ग्रामीण गरीब लोगों के ठहरे रहने के लिए कुछ ज्यादा ही है। यही वह जगह है जहां बहु-अवतान वानिकी में सपरीक्षण करने की जरूरत है, जिसमें जल्दी प्राप्ति देने वाली नकदी फसलें जैसे सबई घास (इयुलालियोप्सिस बायनाटा) इत्यादि वृक्ष-फसल के द्वितीय अवतान के रूप में

उगाई जा सकती हैं। जहां संभव हो वहाँ, वृक्षों के बीच छोड़ी जाने वाली जगह का उपयोग ऐसी कृषि-फसलें उगाने के लिए किया जा सकता है जो वानिकी फसलों के साथ उगाई जा सकती हों। ऐसी अतर्वर्ती फसलें परिस्थिति-विकास वनीकरण परियोजनाओं में साथ देने वाले लोगों को तात्कालिक आर्थिक प्रत्याय उपलब्ध कराएगी और उससे लोगों की प्रिय और सक्रिय भागोदारी इन प्रयत्नों में मिलेगी। प्रस्तुत अभिपत्र में छोटे स्तर पर लाभ प्राप्तकर्ताओं द्वारा जो सभी स्त्रियां थी, वनीकरण के साथ अन्तर्वर्ती फसलें उगाने की परिस्थिति-विकास परियोजना चलाने की सफलता कथा वर्णित की गई है।

SILVO-PASTURE PRACTICES ON LATERITIC TRACT OF SOUTH WEST BENGAL

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Introduction

The lateritic tract of South Western Bengal covers the districts of Bankura, Purulia, part of Birbhum, Bardhaman and Midnapur.

The climate of the area is characterised by a fairly long and hot summer–maximum 49°–and a short winter. Precipitation of monsoon rains between June and September is also scanty providing annual rainfall from 1000 mm to 1400 mm approximately.

Expansion of agriculture in this part took place without any planning and control in the past. So, the tract bears distinct evidence of moderate to extreme losses of soil, complete disappearance of humus. So large areas of the tract are unproductive so remain barren.

The forests exist as enclaves or borders around the agricultural field. All the forests and shrubs bearing areas were vested to the government by 1955 as per Estate Acquisition Act and were notified enmasse as protected forests under the Indian Forest Act and full control of management was assumed by Forest Department. Unfortunately the management of these forests suffered badly due to illicit felling and uncontrolled grazing. Policing attempt to control grazing and illicit felling caused mistrust between foresters and rural communities.

The people of these areas practice single crop agriculture. Paddy is the principal crop grown during rains. Due to large scale paddy cultivation in rains grazing in most of the village land is not possible. Further, hardly any green grass is available during January to April. So the large number of cattle which the villagers maintain are left to wander finding their food. As a result the pressure of grazing in forests is excessive resulting degradation of forests. These cattle have little value as source of milk. They are mostly maintained as source of manure.

Social Forestry Project was initiated in the State in early eighties to bring the village people formally into the management system and to make production system more responsive to community needs. This has resulted into development of the following approaches for working with rural communities (a) Farm and Group Farm forestry (encouraging farmer to grow plants in their hitherto unutilized wasteland), planting of trees in underutilized public lands (roadside, canal banks, railway side, village commons, etc.), management and protection of natural forests by peoples participation, practice of agro-forestry and silvopasture as a means of landuse. This article will focus about silvopasture system developed in the area. This system is practised to get livestock outside forests. So, the Social Forestry Wing is involved in fodder production in South West Bengal on Forestry and private lands through fuelwood and fodder project of Government of India in which 3300 ha were planted over three years (1987-89).

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Methodology

Fuelwood species like *Eucalyptus* and *Acacia auriculiformis* fodder tree species like *Sesbania grandiflora, Leuceana leucocephala* in South West Bengal are planted at a spacing of 4 m × 1.5 m apart and the fodder species like *Pennisetum pedicellatum* (Dinanath) *P. polystachyan* (thin napier), *Stylosanthum guianensis* CV *Schofield*, *S. scabra*, *S. humilis* and *S. hemata* are planted/sown in between the lines of tree species. The land is ploughed and manured with 2-3 ton farmyard manure. Diammonium phosphate 50 kg per ha, urea 25 kg per ha are applied. After first year annually 50 kg of urea is applied. In case of Stylo, application of cowdung two tons and one hundred kg of superphosphate is applied.

Thinning : Alternate trees of fuelwood are removed in 3rd year and 5th year and fodder tree are pollared at 1.2 m height after 1st season of growth and repeated upto 5th year.

Felling : The fuelwood species will finally be felled in 7the and 8th year.

Yield : The average yield obtained from grass and legume fodder in various areas of laterite zone is given in Table 1.

Results and Discussion

Generally the farm forestry or group farm forestry plantation created in wasteland is having very little undergrowth after two years of its growth. Whereas due to intercropping with grass and legumes the eroded land surface is covered with thick mat of vegetation. This is preventing soil wash and also improving the moisture and organic matter. This is especially in case of legume fodder like *Stylogenthus guianensis* CV *Schofield*. This legume is providing fodder to the farmers in the pinch period (in rains when the fields are under cultivation and in dry season up to March when green grass is

Table 1

Average yield obtained from grass and legume fodder in various areas of lateritic zone

Species	Soil	Fodder yield Quintal/ha/year		
		1st yr.	2nd yr.	3rd yr.
S. guianensis, CV. *Schofield*	Laterite	170	125	112
S. guainensis, CV. *Scabra*	”	125	118	100
P. pedicellatum	”	250	200	180

not available) Green fodder (legume) is not usually available to the animals in this area. The legumes fodder is rich in protein and can replace the concentrates It has been investigated by the Animal Resources Directorate. Govt of West Bengal that 20 kg of green fodder can replace 2 kg of concentrates as a part of daily diet of milching cow. Similarly, *Pennisetum pedicellatum*. an annual grass which grows well in the lateritic soil, if fed fresh and adlibitum can sustain a milk yield of 5 to 7 liters per day without concentrates Though the practice is promising, but the farmers in most of the areas are not interestad for cut and carry method of feeding in view of their large number of low productive cows. Further grazing of such huge cattle population in the limited pasture area is not practicable.

Research needs

Alley farming : The trees like *Leucaena*, *Gliricidia* or *Sesbania* may be sown in dense hedge rows and herbaceous forage may be grown in between. The leaves of the trees may be used to feed livestock as well for improving soil and moisture.

Underplanting of shrubs : *Desmodium*, a natural component in peninsular sal forests as well as *Leucaena*, *Pueraria*, *Centrosema* may be tried as understorey crops in plantations. Besides selection and improvement of the natural fodder shrubs/grass need to be taken up.

Management of fodder trees : Fodder tree crops like several species of *Ficus* (*C. roxburghii*, *F glomerata*, *F. nemoralis*) *Albizia*, *Trema*, *Bauhinia* species etc. are commonly used as fodder tree in this area. Studies are to be taken up on growth, yield of fodders from these trees under different pollarding regimes.

Nutrient studies of fodder trees : The degestible crude protein and other digestible nutrients of the various trees commonly grown are to be determined and feeding trials need to be carried out. The nutrient content of some of the commonly grown trees of West Bengal carried out by Nag (1990) in collaboration with the Forest Department is given in Table 2. This table indicates that most of the species contain 20 to 38% of crude protein.

Conclusion

There is urgent need for reduction of unproductive cattle population in the State. The figure of last two census indicate increase in 31.2% cattle population in the State against All India average of 6%. In West Bengal total area under crop is 5.6 m ha out of which 0.26% is estimated to be sown as fodder crops. The traditional common lands virtually disappeared due to extension of agriculture and surplus lands unfit for cultivation is gradually being converted into forest plantations. So, animals are greatly restricted in their access to forage and thus forest lands are being subjected to increase pressure of grazing. So, practice of silvo-pasture along with the improvement of cattle and reduction of unproductive cattle is essential to bring socio-economic development of the villagers.

Table 2

Percent Proximate Components (on DM basis) of some Fodder Tree Leaves (Mean ± SE)

Tree Name	Family	Dry Matter	Crude Protein	Total Ash	Acid Insoluble Ash	Crude Fat	Crude Fibre	Nitrogen Free extract
1	2	3	4	5	6	7	8	9
Acacia suma	Legu.	30.82 ± 0.36	22.20 ± 0.12	6.61 ± 0.27	3.40 ± 0.24	17.40 ± 1.06	13.35 ± 0 20	46.00 ± 0.32
Adenanthera pavonina	Legu.	34.50 0.95	22.20 0.12	7.74 0.37	3.87 0 26	16.38 0 86	11.90 0.19	42.00 0 29
Ailanthus excelsa	Sima.	22 62 0.47	20.81 0.23	9.50 0.38	4.53 0 28	18.52 0.22	13.54 0.16	38.30 0.65
Albizia lebbek	Legu.	25.40 0 43	24.64 0.42	6.63 0 38	2.20 0.28	20.53 0.30	25 88 0 21	23.30 0.95
Albizia procera	Legu.	22.62 0 47	26 66 0.18	8.20 0.42	3.60 0.28	25.27 0.26	13.34 0.18	27.11 0.58
Anthocephalous cademba	Rubi.	12.30 0.38	20.54 0.15	5.80 0.35	1.51 0.25	16.32 0.72	13.72 0.15	43.96 0.34
Cassia nodosa	Legu.	22.00 1.47	22.56 0.17	3.93 0.43	1.58 0.29	24.14 0.16	24.35 0.20	25.60 0 54
Cassia siamea	Legu.	24.76 0.38	24 72 0.17	6.45 0.38	3.70 0.17	20.54 0 30	12.94 0 09	35 90 0.55
Cassia tora	Legu.	19.50 0.65	21.75 0.15	7.87 0.35	1.31 0 25	20.45 0.25	13.20 0.18	37.27 0.58
Dalbergia latifolia	Legu.	22.80 0.51	24 69 0.39	8.65 0.48	1.55 0.28	17.72 0.89	21.39 0 22	28.09 0 39

(*Contd.*)

1	2	3	4	5	6	7	8	9
Dalbergia sissoo	Legu.	20.20±0.39	22.73±0.33	7.77±0.41	2.11±0.25	20.57±0.26	31.54±0.18	28.27±0.88
Giliricidia maculata	Legu.	17.27 0.43	32.13 0.29	9.99 0.29	2.11 0.24	15.57 0.37	12.30 0.13	30.34 0.19
Moringa oleifera	Mori.	16.73 0.42	25.70 0.32	13.12 0.32	1.65 0.25	20.64 0.38	5.92 0.14	35.28 0.66
Peltophoum pterocarpum	Legu.	28.55 0.22	21.08 0.46	6.50 0.36	1.72 0.28	11.40 0.60	8.08 0.14	53.26 0.34
Pongamia pinnata	Legu.	38.67 0.48	19.71 0.47	11.37 0 28	7.34 0.29	15.08 0.34	15.90 0.11	38.45 0.53
Samanea saman	Legu.	25.95 0.47	33.45 0.36	5.03 0 31	1.89 0.23	19.05 0.15	8.46 0.15	35.71 0.89
Sasbania grandiflora	Legu.	23.43 0.19	33.77 0.29	8.33 0.28	2.72 0.25	18.29 0.17	12.08 0.11	27.54 0.61
Toona ciliata	Meli.	22.66 0.27	20.52 0.24	9.12 0.28	5.54 0.28	18.10 0.36	14.76 0.14	38.19 0.45
Trema orientalis	Urti.	19.33 0.19	25.08 0.29	18.57 0 28	11.80 0 20	12.30 0.31	19.16 0.13	25.60 0.43
Trewia nudiflora	Euph.	16.46 0.21	19.40 0.87	8.90 0.22	2.46 0.26	15.78 0.19	19.23 0.12	37.01 0.41

Legu. = Leguminosae, Sima. = Simaroubaceae, Rubi. = Rubiaceae, Mori. = Moringaceae, Meli = Meliaceae, Urti. = Urticaceae, Euph. = Euphorbiaceae.

SUMMARY

Silvo-pasture practice is carried out in laterite tracts of South West Bengal. Adoption of this practice helps in increasing yield of fodder in the pinch period of the year as well as helps in soil and water conservation. Among the various fodder species tried *Stylogenthus guinansis* CV *Schofield* has shown promise to its maximum extent. Though practice is showing promise but the farmers in most of the areas are not interested for cut and carry method of feeding in view of maintenance of low productive cows. So, the reduction of unproductive cows and maintenance of high yielding cattle will facilitate the adoption of stall feeding and the practice of silvo-pasture will be popular.

दक्षिण-पश्चिमी बंगाल के इष्टकिजोय क्षेत्र में चलाई जा रही वन संवर्धन-गोचारण प्रक्रियाएं

ए०के० लाहिड़ी

साराँश

वन सवर्धन-गोचारण प्रक्रियाएं दक्षिण-पश्चिमी बगाल के इष्टकिजय क्षेत्रों में चला करती हैं। इन प्रक्रियाओं को अपनाने से वर्ष में चारे की कमी पड़ने वाले समय में चारे की प्राप्ति बढ़ जाती है और साथ-साथ मृदा और जल सरक्षण भी होना है। इसके लिए परीक्षित कुछ चारा वृक्ष-जातियो में से स्टायलोगेन्थस गिनैसिस कृषिकृत विभेद शोफील्ड सर्वाधिक सीमा तक उत्साहप्रद रही है। यह प्रक्रिया उत्साहप्रद लग रहो है किन्तु इन अधिकाँश क्षेत्रों में किसानों की कम दूध देने वाली अपनी गायों को खिलाने के लिए इसे काटकर ले जाने में रूचि नहीं है। अतः अनुत्पादक गायें कम करने और अधिक दूध देने वाली गाये बढ़ाने से खूंटे बाँधकर गाय पालने की रीति अपनाने की सुविधा बढ़ेगी और वन सवर्धन-गोचारण प्रक्रिया भो लोकप्रिय बनेगी।

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STUDIES ON THE EFFECT OF AUXIN AND SEASON ON ROOTING STEM CUTTINGS OF SOME IMPORTANT SHRUBS IN NURSERY BEDS

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Introduction

Like trees, shrubs provide a veritable range of valuable products e g. fuel, fodder and medicinal–aromatic substances of commerce. Also, shrubs outmanouvre tree vegetation in colonising degraded areas, as better adapted to withstanding drought, frost and fire than the latter. Their tenacity to grow on skeletal soils provide them the added advantage of introduction in poor sites and wasteland afforestation. Moreover, importance of shrubs as an under-storey in forest system and in augmenting the present meagre fuel and fodder supply to rural masses needs to be better appreciated.

Vegetation has an important role to play in increasing biomass production through use of site specific and screened planting material in afforestation programmes (Brix and an Vden Driessche, 1977; Zobel, 1981) specially the poor and degraded sites (Maithani *et al.*, 1988). Shrubs have received little attention so far, therefore the present investigation on rooting stem cuttings of some important shrub species was carried out during different seasons of the year 1988-89.

Material and Methods

Stem cuttings of *Debregeasia hypoleuca*, *Coriaria nepalensis*, *Woodfordia floribunda* and *Berberis lycium* were prepared from current year shoots of shrubs growing in the farm area of Dr. Y.S. Parmar University of Horticulture and Forestry, Nauni (Solan). Cuttings packed in bundles were brought to the laboratory in plastic bags. The following day, they were trimmed to 18 cm length and leaves and buds removed from basal 10 cm portion with sketeurs. Cuttings were thereafter divided in ten groups of ten cuttings each and soaked in 4-5 cm auxin solutions in beakers for 24 hours. The treatments tested were : control; IAA 100 mgl^{-1}; IAA 400 mgl^{-1}; IAA 700 mgl^{-1}; IBA 100 mg l^{-1}; IBA 400 mgl^{-1}; IBA 700 mgl^{-1}; NAA 100 mgl^{-1}; NAA 400 mgl^{-1} and NAA 700 mgl^{-1}.

On expiry of the prescribed period of dip, cuttings were removed, the basal ends washed and then set 10 cm deep, spaced 30 cm × 30 cm in nursery beds. Powder formulation treatments used only in monsoon planting consisted of : control; talc; 1% IBA; 0.5% IBA-talc; 0.25% IBA-talc; activated charcoal (AC); 1% IBA-AC, 0.5% IBA-AC

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and 0.25% IBA-AC. Powders were prepared by dissolving the calculated quantity of IBA in ethyl alcohol, then making a slurry with talc or AC; evaporating the ethyl alcohol and sifting and finally stored in plastic containers for later use. These formulations were applied to cuttings so as a small amount adhered to their base.

The experiments were laid in a randomised block design; there being ten treatments each replicated thrice with ten cuttings per plot. In all 4800 cuttings with 1200 samples per species were treated during the year 1988-89. Observations on rooting per cent, number of roots per cutting, root length (cm), callus formation were recorded after 30, 45 and 70 days of planting. Per cent data were transformed to arc sine $\sqrt{\text{proportion}}$ for analysis of variance.

Results and Discussion

Both, season as well auxin application influence rooting (Table 1 and 2), there being complete failure during winter months. Apparently, food reserves required to initiate root initials during this period were too low or dormancy in the plants renders rooting difficult. Welander (1978) and Hansen *et al.* (1978) have shown strong relations between carbohydrate, nitrogenous compounds, auxin and adventitious root formation.

Effect of season

Debregeasia hypoleuca and *Woodfordia floribunda* rooted best in spring with a maximum 67.67 per cent and 30 per cent success when cuttings were treated with 100 mgl^{-1} IBA and 100mgl^{-1} NAA respectively. Rainy season yielded 53 33 per cent and 26.67 per cent rooting with cuttings soaked in 400 mgl^{-1} IBA solution. Apparently, endogenous auxin levels appear to have fallen by the time cuttings were again tried in rainy season which otherwise restricted the root initiation. Our results with *D. hypoleuca* confirm this as control and IBA 100 mgl^{-1} resulted in 23.33 per cent and 40 per cent rooting respectively. Therefore, to achieve higher percentage the threshold value of endogenous auxin must be raised to an optimum level i e. 400 mgl^{-1} IBA, thus providing a maximum 53.33 per cent rooting during the rainy season.

Nanda *et al.* (1970), Nanda and Anand (1970) and Nanda (1970) demonstrated that seasonal changes in auxins effects on rooting are related to changes in the levels of endogenous regulatory substances and nutritional status of cuttings. These in turn are caused by temperature and day light changes experienced during annual cycle of plant growth.

Similar is the case with *W. floribunda* which revealed a maximum rooting of 26.67 per cent in rainy season. 1% IBA-AC enhanced rooting to 63.33 per cent in *D. hypoleuca* while supressed it to 6.67 per cent in *W. floribunda* (Table 3). However 1% IBA in talc proved beneficial for the latter giving a maximum 26.67 per cent success in rainy season.

Though statistically at par, *C. nepalensis* produced slightly better results in rainy season, giving 53.33 per cent rooting compared to 50.00 per cent in spring, when cuttings were treated with 100 mgl^{-1} IBA and 400 mgl^{-1} IBA respectively. 0.5% IBA-AC formulation further enhanced rooting to 56.67 per cent in the rainy season (Table 3).

Table 1

Effect of IAA, IBA and NAA on rooting of stem cuttings in some important shrubs during spring 1988-89

Treatment mg/l	*Debregeasia hypoleuca*			*Coriaria nepalensis*			*Woodfordia floribunda*		
	%R^Z	N	L	%R^Z	N	L	%R^Z	N	L
Control	30.99 (26 67)*	10.11	7.44	28 78 (23.33)	6.67	2 72	18.44 (10.00)	6.83	1.40
IAA 100	35.22 (33.33)	16.11*	12.22*	30 90 (26.67)	7.33	3.11*	23.85 (16.67)	8.33*	1.77*
IAA 400	39.23 (40.00)	18.89*	15.44*	35.22 (33.33)	8.00*	3.22*	26.56 (20.00)*	9.83*	2.37*
IAA 700	33.00 (30.00)	13.33	11.28*	41.15 (43.33)*	9.67*	4.11*	23.85 (16.67)	11.94*	2.57*
IBA 100	54.78 (67.67)*	29.89*	20.11*	43.08 (46.67)*	10.56*	4.89*	23.85 (16.67)	11.00*	2.07*
IBA 400	45.00 (15.00)*	21.89*	16.89*	45.00 (50.00)*	11.89*	5.78*	28.78 (23.33)*	13.22*	3.03*
IBA 700	41.07 (43.33)*	18.67*	15.45*	38.85 (40.00)*	8.78*	4.28*	30.99 (26.76)*	13.83*	4.27*
NAA 100	35.01 (33.33)	15.17*	10.83*	41.15 (43 33)*	9.78*	4.22*	33.00 (30.00)*	18.83*	6.57*
NAA 400	39.15 (40.00)	19.22*	15 33*	39.23 (40.00)*	9.11*	4.11*	28.78 (23.33)*	13.06*	4.87*
NAA 700	37.22 (26.67)	18.89*	12.44*	37.22 (36 67)*	8.67*	3.89*	23.85 (16.67)	8 33*	2.40*
SEm ±	4.38	1.78	0.77	4.14	0.52	0.43	3.57	0.60	0.10
CD 5%	9.19	3.74	1.62	8.69	1.09	0.09	7.50	1.27	0.22

%R — Percentage rooting, N — Number of roots per cutting, L — Average root length (cm).
Z — Each value is the mean for 30 cuttings.

* Significant at 5 per cent l.o.s.

Figures in parenthesis are the actual values and those outside are the transformed values.

Table 2

Effect of IAA, IBA and NAA on rooting of stem cuttings in some important shrubs during rainy season 1988-89

Treatment mg/l	*Debregeasia hypoleuca*			*Coriaria nepalensis*			*Woodfordia floribunda*		
	%R^Z	N	L	%R^Z	N	L	%R^Z	N	L
Control	28.78 (23.33)	7.17	6.78	30.99 (26.67)	7.50	2.72	6.37 (3.33)	1.55	1.17
IAA 100	30.99 (26.67)	11.00x	7.67	33.00 (30.00)	9.11x	3.56	18.44 (10.00)	2.71	1.55x
IAA 400	35.00 (33.33)	12.95x	9.44x	37.22 (36.67)	12.44x	4.11x	21.15 (13.33)	2.77x	1.57x
IAA 700	33.00 (30.00)	13.17x	7.56	30.99 (26.67)	10.28x	4.33x	6.37 (3.33)	1.61	1.18
IBA 100	39.15 (40.00)x	21.33x	13.89x	46.92 (53.33)x	21.56x	7.67x	18.44 (10.00)	2.89x	1.65x
IBA 400	47.00 (53.33)x	21.67x	16.11x	43.08 (46.67)x	15.89x	6.11x	30.78 (26.67)x	3.61x	1.92x
IBA 700	30.99 (26.67)	12.39x	8.44x	39.15 (40.00)	13.67x	5.56x	21.15 (13.33)	2.94x	1.69x
NAA 100	37.22 (36.67)	19:00x	13.22x	41.15 (43.33)x	16.22x	6.22x	12.40 (6.67)	2.30	1.38
NAA 400	33.00 (30.00)	13.22x	8.89x	43.08 (46.67)x	20.56x	6.67x	6.37 (3.33)	1.61	1.18
NAA 700	28.78 (23.33)	10.67x	6.67	35.22 (33.33)	15.00	4.22x	0.33 (0.00)	1.00	1.00
SEm ±	4.85	1.28	0.68	3.89	0.72	0.46	7.43	0.57	0.16
CD 5%	10.18	2.69	1.42	8.17	1.51	0.96	15.61	1.20	0.34

%R — Percentage rooting, N— Number of roots per cutting, L — Average root length (cm).
Z — Each value is the mean for 30 cuttings.

x Significant at 5 per cent l.o.s!

Figures in parenthesis are the actual values and those outside are the transformed values.

Table 3

Effect of IBA-talc and IBA-activated charcoal formulations on rooting of stem cuttings in some important shrub species during rainy season 1988-89

Treatment mg/l	*Debregeasia hypoleuca*			*Coriaria nepalensis*			*Woodfordia floribunda*		
	$\%R^Z$	N	L	$\%R^Z$	N	L	$\%R^Z$	N	L
Control	28.78 (23.33)	7.17	30.00	30.99 (26.67)	7.83	33.33	6 37 (3.33)	1.55	1.77
Talc	33.21 (30.00)	12.11x	96.67x	33.21 (30.00)	10.44x	33.33	6.37 (3.33)	1.61	1.77
0.25% IBA-talc	35.22 (33.33)	24.00x	150.00x	45.00 (50.00)x	19.88x	46.67x	12.40 (6.67)	2.28	3.00
0.05% IBA-talc	43.07 (46.67)x	26.00x	170 00x	35.22 (33.33)	15.33x	36.67	26.56 (20.00)x	3.83x	5.24x
1.0% IBA-talc	30 99 (26.67)	12.83x	50.00x	28.78 (23.33)	11.33x	26.67	30.99 (26.67)x	4.20x	5.57x
Activated charcoal	33.21 (30.00)	11.50x	36.67x	35.21 (33.33)	11.67x	26.67	0.33 (0.00)	1.00	1.00
0.25% IBA-AC	33.00 (30.00)	15.72x	66.67x	39.14 (40.00)x	19.33x	56.67x	6.37 (3.33)	1.55	1.77
0.5% IBA-AC	37.22 (36.67)x	21.67x	116.67x	48.85 (56.67)x	21.78x	93.33x	12.40 (6.67)	2.44	3.00
1.0% IBA-AC	52.77 (63.33)x	26.67x	206.67x	33.21 (30.00)	6.17	10.00	12.40 (6.67)	2.49	3.39
SEm ±	3.12	0.48	5.49	3.32	0.70	4 58	7.46	0.79	1.15
CD 5%	6.61	1.02	11.64	7.04	1.48	9.71	15.82	1.67	2.44

%R — Percentage rooting, N — Number of roots per cutting, L — Total root length (cm).
Z — Each value is the mean for 30 cuttings.

x Significant at 5 per cent l.o.s.

Figures in parenthesis are the actual values and those outside are the transformed values.

Effect of auxins

In *D. hypoleuca* all treatments produced roots regardless of auxins or medium used i.e. water, IBA, IAA or NAA. The new roots were found to emerge from base as well sides. IBA 100 mgl^{-1} and 400 mgl^{-1} treatments resulted in a maximum 67.67 per cent and 53.33 per cent rooting in spring and rainy season respectively. Highest average root length (20.11 cm) and number (29 89) were recorded in cuttings treated with 100 mgl^{-1} IBA solution. Rooting results for IAA, and control were statistically at par, being inferior to those of IBA treated cuttings.

C. nepalensis appeared moderately hard to root species under field conditions, the rooting varying from 23.35 to 50.00 % in spring and 26.67 to 53.33 % in rainy season. Rooting response as well quality declined as concentration of auxins increased. It is evident from the study that auxin treatment triggered adventitious root formation almost doubling it over control. Maximum 53.33 per cent rooting was obtained when cuttings treated with 100 mgl^{-1} IBA were struck in rainy season. Higher root number (21.56) as well average root length (7.67 cm) were recorded in 100mgl^{-1} IBA treated cuttings in rainy season. NAA soaking enhanced rooting and callus formation over IAA and control cuttings in both the seasons. Rooting increased qualitatively as well as quantitatively when cuttings were dipped in 0.5% IBA-AC formulation just before sticking in the nursery beds.

Study revealed *W. floribunda* difficult to root species as only 30 per cent and 26.67 per cent success was achieved when cuttings were treated with 100 mgl^{-1} NAA and 400 mgl^{-1} IBA in spring and rainy season respectively. It was obvious that auxins promoted root initiation, as only 3 to 10 per cent of control cuttings rooted in both the seasons. Bahuguna *et al.* (1988) reported that cuttings soaked in 200 ppm IBA promote rooting in *W. fructicosa* when struck in monsoon season. Average root length and number was found to be maximum in plots treated with 100 mgl^{-1} NAA during spring.

A neglegible success in rooting cuttings (<7 per cent) was obtained in *B. lycium* when cuttings were treated with 100 mgl^{-1} IBA during spring. Callussing of cuttings was poor, that often rotted at the base. Parmar and Khamu (1989) failed to initiate rooting when auxin treated *B. aristata* cuttings were planted in June and July. They however obtained 35.5 per cent success when branches were air layered with 5000 ppm IBA in July. The hard to root nature may be attributed to presence of some anatomical barriers or inhibitors (Spiegel, 1955; Fadl and Hartmann, 1967) and absence of some rooting cofactors (Hess, 1959, 1965, 1968; Challenger *et al.*, 1965) in the species.

Callus formation appeared 4-6 weeks after treatment but its extent bore little relation to subsequent root formation in all the species. Callus formation was much slower in the controls and often failed to differentiate into root initials. It did not appear in extreme concentrations either, the cuttings generally rotted at the basal ends in 5 to 7 weeks.

SUMMARY

This paper describes the results of experiments on rooting of stem cuttings of *Debregeasia hypoleuca*, *Coriaria nepalensis*, *Woodfordia floribunda* and *Berberis lycium* as affected by season and auxin application. 100 mgl^{-1} IBA and 100 mgl^{-1} NAA gave maximum rooting in *D. hypoleuca* and *W floribunda* respectively during spring whereas, 100 mg^{-1} IBA resulted in better rooting of *C. nepalensis* during rains. Rooting of *C. nepalensis* was enhanced when cuttings were dipped in 0.5 per cent IBA-AC during rainy season. *B lycium* failed to initiate roots irrespective of season and auxin application.

रोपणी की क्यारियों में कुछ महत्वपूर्ण क्षुपों की स्तम्भ कलमें लगाने पर उनमें जड़ें निकलने पर आँक्सिनों और मौसम के प्रभाव का अध्ययन

एन०के० जोशी, एस० शर्मा, जी०एस० शामेट व आर०सी० धीमान

साराँश

इस अभिपत्र में डेब्रेजिएसिया हाइपोल्यूका, कोर्येरिया नेपालेंसिस, वुडफोर्डिया फ्लोरिबडा और बर्बेरिस लीसियम की स्तम्भ कलमों में जड़ें निकलने पर मौसम और आँक्सिन देने के सपरीक्षणों के परिणाम दिए गए हैं। 100 मिग्रा प्रति लीटर इण्डोल ब्यूटिरिक अम्ल और 100 मिग्रा प्रति लीटर न्यूवलिक एसेटिक अम्ल क्रमशः डे० हाइपोल्यूका और वु० फ्लोरिबडा में देने पर उनमें बसत में अधिकतम जड़ें निकली जबकि 100 मिग्रा प्रति लीटर इण्डोल ब्यूटिरिक अम्ल को० नेपालेंसिस में देने पर उसमें वर्षा ऋतु में श्रेष्ठतर परिणाम मिले। को० नेपालेंसिस की कमलों को 0.5% इण्डोल ब्यूटिरिक अम्ल-एसी में डुबोने पर वर्षा ऋतु में उसमें जड़ें निकलना बढ़ गया। ब० लीसियम में किसी भी मौसम और कोई भी आँक्सिन देने के वावजूद जड़ें निकलना आरम्भ नहीं हुआ।

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PROPAGATION, SELECTION AND ESTABLISHMENT OF CLONAL SEED ORCHARD OF CHILGOZA PINE (*PINUS GERARDIANA* WALL.)

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Introduction

Pinus gerardiana Wall. known as Chilgoza or Neoza is most important tree cash crop among fine *Pinus* species reported from the country. Its distribution is restricted to dry inner valleys of North-West Himalayas between 1600 to 3300 metres elevation. The main source of Chilgoza nut (seed) in India is Sutlej Valley of District Kinnaur in Himachal Pradesh. The total area under this crop is around 2500 ha including the plantations raised by State Forest Department and the annual yield of nut varies from 150-180 tonnes per year (Tandon, 1965). It forms predominant vegetation starting from Tapri upto Dubling along the river Sutlej and the best growth is noticed at an altitude of about 2600 m (Dogra, 1964).

By the increasing demand of nut in dry fruit trade of the country, it is now back bone of the livelihood of tribal people of Kinnaur. At the same time the depletion of the crop area and its density is directly linked with no or very meagre natural regeneration due to reckless lopping of branches for the extraction of each and every possible cone even in extreme inaccessable sites. Since the right of harvest of the Chilgoza had been given to local inhabitants that is why there is no check on its way of extraction by State Forest Department.

Pinus gerardiana is very sparsely studied. Chandra and Mahindru (1976) reported the results of air layering. The artificial regeration of Chilgoza pine was studied by Singh *et al.* (1973). Singh (1989, 1990) reported on its clonal propagation and effect of different factors on the success of tender shoot cleft grafting respectively. However, not much work has been done in the genetic improvement of this species except the studying the phenotypic variations of Chilgoza (Kumar, 1986). In order to bring Chilgoza pine under clonal cultivation at part to other fruit crop in dry temperate Himalaya, the efforts have been made on its propagation, selection of plus trees (clones) and the transplanting of grafted plants in an experimental clonal seed orchard at Regional Research Station, Sharbo, Kinnaur. The average annual rainfall at the station was about 500 mm and average temperature varies from 10°C to 35°C during the month of January to July.

The present paper deals with its clonal propagation, selection of plus trees, analysis of variance, coefficient of variation, phenotypic coefficient of variation, genotypic coefficient of variation, heritability, genetic gain for eight characters and the methodology of raising clonal seed orchard of Chilgoza pine.

Material and Methods

Vegetative Propagation : The tender shoot cleft grafting was done in February 1989 and February 1990. The method was followed as described by Dorman (1976). The seedlings of 2-3 years age old raised in polythene bags of 45×15cm size were procured from Forest Range Nursery, Kalpa for the present study. The experiment was laid out in randomized block disign with three replications having 40 plants in each replication. The observations on success percentage were recorded when the grafts started bearing new leaves whereas the percentage of survival was noted in December 1989 and 1990 respectively.

Selection of plus trees and analysis of phenotypic and genotypic variability for cone and nut characters : 20 plus trees were selected in 1989 from different parts of Kinnaur based on five characters viz. height, diameter, crown size, number of cones and seed weight of 100 seeds. The marking of superior (plus) trees was done to only those trees which had given better result for each character to the average of neighbouring five trees termed as candidate trees for the comparison. In 1990, fifteen cones per tree were collected from selected plus trees for further analysis of eight cone and nut characters comprising fresh cone weight, cone length, cone breadth (middle), number seeds per cone, seed weight, seed length, seed breadth (middle) and seed thichness. The mean value of 25 seeds of each plus tree in four replications were used for statistical computation (Table 2). The components of variance and coefficient of variation were calculated. The genotypic coefficient of variation, phenotypic coefficient of variation. heritability genetic advance for eight characters were calculated (Burton and Da Van, 1953; Johnson *et al*, 1955 and Namkoong, 1979).

Establishment of experimental clonal Seed Orchard : 30 grafted plants of three plus trees namely Sharbo, Kalpa and Khawangi were transplanted in December, 1989 in orchard by removing the polythene bags carefully without damaging the root system of the plant. The size of pits was kept 1×1 m and spacing 7 × 7m was given plant to plant. The pits were filled up with earth, forest soil, cow dung (5-7 kg per pit) and fertilizer (N.P.K) in the ratio of 70:35.70 gm per pit. The forest soil was used in the pits as to inocuate mycorrhiza for the better growth of the plants (Mukherjee and Rehill, 1962). The average height and collar diameter of grafts were 13 cm and 04 mm respectively during transplanting out in field. The basins (thali) were prepared of one meter diameter. The proper care was taken for watering (twice in week) specially for six months May to October. The pine needles and local weed were used for mulching in the basin of plants.

Results and Discussion

Vegetative Propagation : The report of Singh (1989) established the fact that tender shoot cleft grafting had given best result in mid of February. The success of grafting was recorded 70% and 60% whereas the grafts

Table 1

Selection of Plus Trees

(The measurement is shown as plus tree upon average of five candidate trees for respective charcter).

Place (Trees Selected)		Height (m)	Diameter (DBH in cm)	Crown size (m^2)	Number of cones	Seed weight (gm) (100 seeds)
1		2	3	4	5	6
Sharbo	Plus	25.00	69.50	45.00	160	51.00
	Av.	23.40	59.00	40.50	95	40.70
Khawangi	Plus	24.50	73.80	49.55	175	56.00
	Av.	20 80	60 50	38.70	120	45.12
Kalpa	Plus	22.70	66.00	46.80	150	58.60
	Av.	19.00	58.77	40.00	108	47.00
Powari	Plus	25.00	70.00	48.55	165	59.00
	Av.	21.00	62.75	41.50	115	47.85
Bogtu I	Plus	26.00	75.00	50 50	160	57.50
	Av.	22.50	64.45	41.00	110	46.00
Bogtu-II	Plus	23.75	70.35	45.59	145	56.00
	Av	19 80	61.00	39.75	100	44 00
Bogtu III	Plus	24.50	71.00	42.80	155	54.65
	Av.	21 00	62.15	35 60	98	41 75
Brua	Plus	22.45	60 00	40.00	140	46.80
	Av.	18 75	51.50	31.00	90	40.33
Kilba-I	Plus	25.75	68.90	47.00	148	54.66
	Av.	22.55	56.50	33.00	110	38 00
Kilba-II	Plus	23.00	65.00	45.39	155	55.00
	Av.	19.00	58.87	34 77	115	40.50
Kilba-III	Plus	21.50	58.17	39.50	138	48.50
	Av.	19.00	53.25	35.00	90	39.75
Shongtong	Plus	23.50	60.00	43.95	150	57.00
	Av.	18.44	55 28	35.77	101	41.83
Karcham	Plus	21.15	58.11	39.50	137	46 85
	Av.	17.67	53.55	33.80	90	39 90
Skibba-I	Plus	23.10	63.50	47 40	155	57 00
	Av.	18.50	55.55	36.75	115	41.85
Skibba-II	Plus	22.67	61.22	49.00	169	58.11
	Av.	17.50	56.15	37.00	105	43 95
Akpa	Plus	21.75	57.65	44.75	160	56.12
	Av.	16.55	52.50	33.67	90	40.88
Chirang Khad	Plus	24.45	62.00	52.11	165	57.50
	Av.	18.66	56.58	38.68	110	42.00

(Contd ..)

1		2	3	4	5	6
Holdo Nallah	Plus	22.75	60.00	47.00	156	57.00
	Av.	17.60	52.50	39.00	95	41.39
Pangi	Plus	21.55	65.00	41.21	129	49.58
	Av.	17 60	59.50	37.94	86	38.80
Ralli	Plus	22.80	67.70	40.77	115	48.00
	Av.	18.90	61.00	36 50	80	32.45

Table 2

Phenotypic Variability in Cone and Nut characters

Name of Plus Trees & origin	Cone length (cm)	Cone breadth (cm)	Cone weight (gm)	No. of seeds per cone	Seed wt. per cone (gm)	Seed length (mm)	Seed breadth (mm)	Seed thickness (mm)
Sharbo (PG-1)	13 76	7 58	485	88 20	36.20	18.09	6.81	5.43
Shongtong (PG-2)	15.72	7 90	572	88 40	36.20	20.85	6.99	5.50
Holdo Nallah (PG-3)	16 16	8.68	608	85 80	42.40	23.87	6.92	6.01
Kilba-I (PG-4)	14 54	8 06	533	78.20	32.60	19.14	6 72	5 54
Kilba-II (PG-5)	15.44	7.60	517	93.60	45.40	23 26	6 81	5.53
Kalpa (PG-6)	14.16	8.06	516	96.80	38.20	19.18	7.01	5.86
Khawangi (PG-7)	18.20	10.90	859	99.60	62.00	24.50	7.68	6.65
Powari (PG-8)	17.96	10.10	738	103.80	50.00	24.78	7.84	6.12
Skibba-I (PG 9)	16.54	9.00	650	75.40	42 00	22.16	7.12	6.12
Skibba-II (PG 10)	12.56	7.98	345	64.80	26.80	19 60	6 73	5.58
Akpa (PG-11)	14.16	7.84	496	88.20	37.60	21 35	6.47	5.41
Chirang Khad (PG-12)	15.96	8.38	573	86 20	37.20	22.13	7.01	5.85
Bogtu-I (PG-13)	15.44	8.56	474	99.60	44.80	19.25	6.75	5.42
Bogtu II (PG-14)	16.22	8.90	675	77.40	30.00	21.25	7.23	5.84
Bogtu-III (P-15)	15.22	8.78	554	90 00	39.00	22.89	7.01	5.98
Range	12 56 18 20	07.58 10.90	345 859	64.80 103 80	26.80 62 00	18.09 24.78	6.47 7.84	5 41 6.65
Mean ± SE	15 48 ±00.45	08.56 ±00.33	573 ±32 55	87.73 ±05 26	40 03 ±02.97	21.49 ±00.25	07.02 ±00.09	05.78 ±00.06
S D.	01.01	00.73	72.90	11.78	06.66	00.55	00.20	00.14
'F' test	×× 10.99	×× 07.89	×× 14.05	×× 03.97	×× 08.23	×× 74.01	×× 18.59	×× 30.50
C.D. at 1%	1.74	1.25	124.48	20.11	11.37	00.95	00.34	00.24

×× — Significant at 1% probability.

showed 65% and 50% survival in 1989 and 1990 respectively. The success and survival of the grafts were decreased in 1990 perhaps due to sudden and heavy snowfall and intermittent rains in last week of February and March. However, such fluctuations in result can be controlled if the grafting would be done in glasshouse.

Selection of plus trees and analysis of phenotypic and genotypic variability for cone and nut characters : Of 20 plus trees selected in Kinnaur, 15 plus trees were finally taken in the present study (Table 1). The plus tree which had attributed more than 42 m² crown area, 140 cones and 50 gm weight of 100 seeds were further screened for the study of 8 economic characters on cone and nut.

The analysis of variance (Table 2) revealed highly significant variability for all the characters under study. It clearly shows that high genetic variability exists in the material. The range of variation for each character showed a good variability for almost all the characters.

As per Table 3, the coefficient of variation was observed maximum in seed weight per cone and minimum in seed thickness. Phenotypic as well as genotypic coeffecient of variation were found high for seed weight per cone followed by number of seeds per cone, cone weight, cone breadth, cone length, seed length, seed thickness and seed breadth. Further, all the estimates of genotypic coefficient of variation was less in magnitude than that of phenotypic coefficient of variation indicating environmental effects on these characters.

Heritability estimates (broad sense) were observed to be maximum in seed length (93.70%) and minimum in number of seeds per cone (37.30%). However, in most of the characters, the heritability was recorded to be high except in number of seeds per cone (Table 4). The expected genetic gain was found to be highest for seed weight per cone

Table 3

Estimates of components of variance and coefficient of variation for eight characters in Chilgoza pine.

Characters.	Phenotypic variance	Genotypic variance	Environmental variance	C.V.	G.C.V.	P.C.V.
Cone length	03.12	02.08	01.04	06.52	09.31	11.41
Cone breadth	01.29	00.75	00.54	08.52	10.08	13.24
Cone weight	19181.52	13867.51	05314.01	12.72	20.54	24.16
Number of seeds per cone	221.32	82.55	138.77	13.42	10.40	16.96
Seed weight per cone	108.45	64.11	44.34	16.63	20.00	26.02
Seed length	04.76	04.46	00.30	02.55	09.82	10.15
Seed breadth	00.18	00.14	00.04	02.84	05.33	06.04
Seed thickness	00.14	00.12	00.02	02.42	05.94	06.43

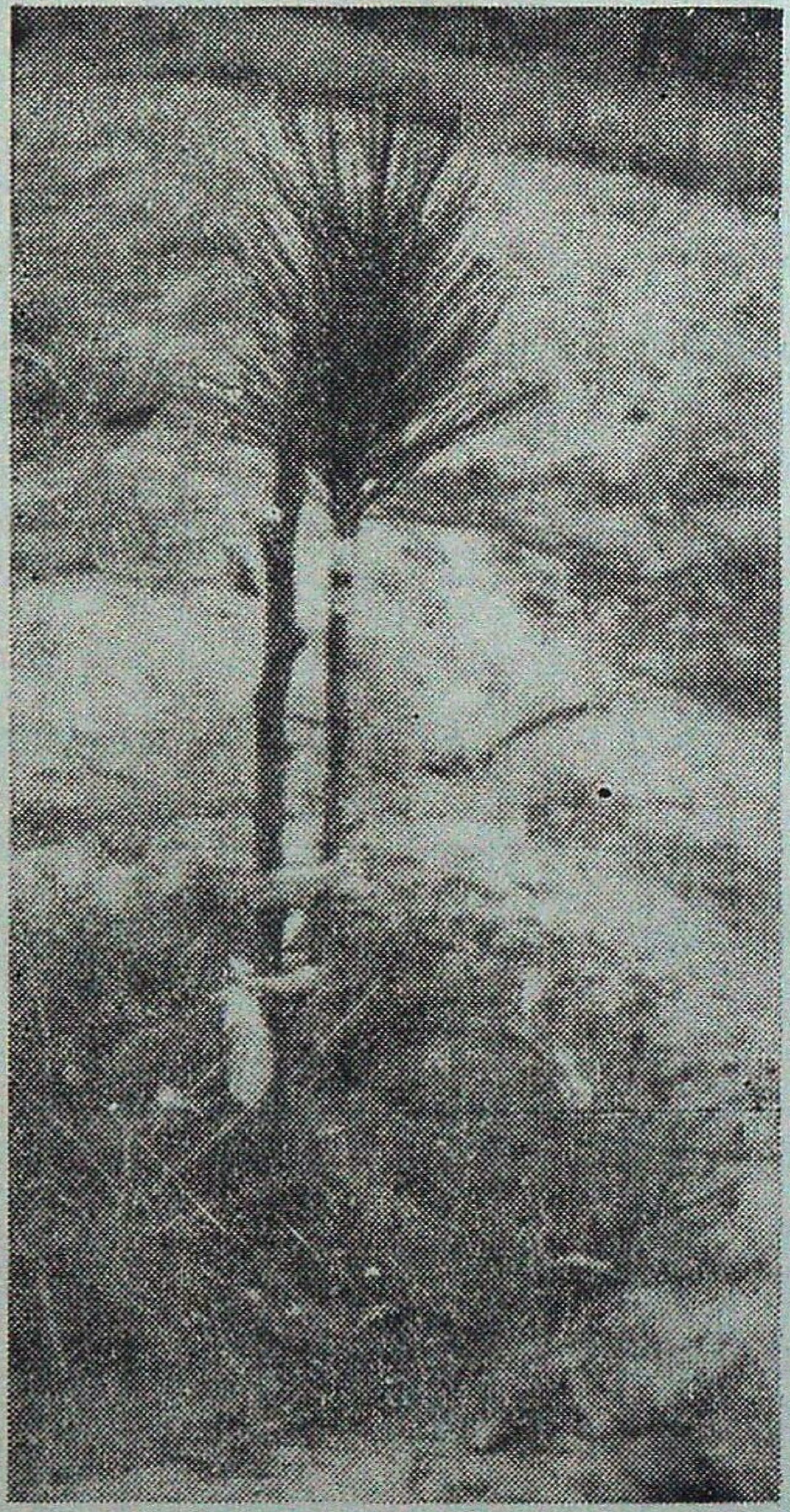
Table 4

Heritability and genetic advance of eight characters in Chilgoza pine.

Characters	Heritability (%)	Genetic advance	Genetic advance as per cent of mean
Cone length	66.66	01.98	12.80
Cone breadth	58.13	01.01	11.79
Cone weight	72.30	70.56	12.31
Number of seeds per cone	37.30	12.95	14.76
Seed weight per cone	59.11	11.80	29.47
Seed length	93.70	05.10	23.73
Seed breadth	77.78	00.87	12.39
Seed thickness	85.71	00.66	11.47

(29.47%) and lowest in seed thickness. Seed weight provide a sufficient amount of genetic variability as it is evidenced from GCV and PCV estimates in combination with heritability. GCV alone is not a correct estimate to know the heritable amount of variation present in the species for a given trait. It should be considered together with heritability estimates to obtain the best picture of the amount of genetic advance to be expected from the selection (Burton and Da Vane. 1953). High heritability estimates are useful in making selection of superior phenotypes (plus trees) on the basis of phenetypic performance of quantitative characters. Johnson *et al.* (1955) reported that heritability estimates along with expected genetic gain is more useful than the heritability itself in predicting the resultant effect for selecting the best genotypes. The results of present study (Table 4) clearly proves that it is not necessary that high heritability should always yield high genetic gain (Singh and Uppal, 1977). Keeping in mind the above facts and results of the study, the attention should be paid upon selection of seed weight and cone size for

Fig. 1



A ramet in the orchard of Chilgoza pine at Regional Research Station, Sharbo, Kinnaur (H.P.)

evolving high yielding genotypes by adopting suitable breeding procedure.

Establishment of experimental clonal seed-orchard: The average height and collar diameter was recorded 22.5 cm and 6.75 mm respectively in December 1990 (Fig. 1) 7 plants were dried perhaps due to sudden rain and snowfall which resulted over flooding of water and silt in March, 1990. The grafting will be done in large scale in February. 1991 by using superior genotypes for quality and quantity nut production (Table 3 and 4). Thereafter more area will be brought under seed orchard.

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The author wishes to record his sincere gratitude to Dr. P.D. Dogra. N.B.R I., Lucknow for fruitful suggestions. Thanks are due to Dr. R V. Singh (Ex D.G.-ICFRE) for the comment and encouragement on clonal propagation. Thanks to Dr. S D. Sharma, Chief Scientist, RHRS., Sharbo for providing all sorts of facilities in the present study.

SUMMARY

Clonal propagation was standardized in Chilgoza pine. 20 plus trees were selected from 15 different places of Kinnaur in Himachal Pradesh. Information on variability, heritability and expected genetic gain (genetic advance as per cent of mean) were obtained for eight cone and nut characters. In general, heritability estimates were quite high for most of the characters. Seed weight per cone provides lot of variability, high heritability and maximum genetic gain (29.47 followed by seed length and number of seeds per cone. Seed weight per cone should be given top priority for selecting the high yielding genotypes. Experimental clonal orchard was established by using three plus trees.

चिलगोजा (पाइनस गेरार्डियाना वालि०) के कृन्तक बीज उद्यानों का प्रवर्धन, प्रवरण और स्थापना

एन०बी० सिह

साराँश

चिलगोजा के कृन्तक प्रवर्धन को प्रतिमानित किया गया। हिमाचल प्रदेश में किन्नौर क्षेत्र के 15 विभिन्न स्थानों से श्रेष्ठ वृक्ष चुने गए। 8 शकुओं और अष्ठिफलों की विभिन्नीयता, पित्रागम्यता और प्रत्याशित आनुवंशिक लाभ (माध्य से आनुवंशिक वृद्धि प्रतिशत रूप में) की जानकारी इकट्ठी की गई। सामान्यत: अधिकांश लक्षणों में पित्रागम्यता के अनुमान काफी उच्च रहे। प्रति शंकु बीज का भार से ही विभिन्नीयता, उच्च पित्रागम्यता और अधिकतम आनुवंशिक लाभ (29.47) की बहुत सी जानकारी मिल जाती है जिसके बाद बीज की लम्बाई और प्रति शंकु बीजों की सख्या आते हैं। प्रति शंकु बीजों का भार को अधिक प्राप्तिदायक समगित्रैक चुनने के लिए सर्वाधिक प्राथमिकता देनी चाहिए। तीन श्रेष्ठ वृक्ष लेकर संपरीक्षात्मक कृन्तक उद्यान बनाया गया।

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EVALUATION OF COAL MINE SPOIL AS A MEDIUM FOR PLANT GROWTH IN A DRY TROPICAL ENVIRONMENT, INDIA

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Introduction

During mining activites overburden strata displacement may contain materials that may be unfavourable or potentially unfavourable to plant growth (Chichester, 1983). Several workers have identified salinity, acidity, poor water-holding capacity, inadequate supplies of plant nutrients, high rates of litter accumulation, accelerated rate of erosion and spoil texture, as major problems in coalmine spoils that affect revegetation process (Down, 1975; Archibold, 1980; Wali and Freeman, 1973; Safaya and Wali, 1979; Reeder and Berg, 1977; Jha and Singh, 1990).

Soil fertility is a major factor which regulates plant growth Several investigators have reported N and P as limiting growth factors in mine spoils. Day *et al.* (1979) observed in growth chamber experiments that even with adequate irrigation but without proper fertilization, plant growth in spoils and top soil materials was extremely poor. Lack of mineralizable organic N and lower mineralization rates affect the availability of N to plants in mine spoils (Reeder and Berg, 1977).

No data on suitability or unsuitability for plant growth for Indian coal mine spoils are available. Therefore, the objective of this study was to evaluate the mine spoils of different ages of Jhingurda Colliery, Northern Coalfields, Ltd., Singrauli, as a medium for plant growth.

Materials and Methods

The study sites are located in the vicinity of tropical mixed dry deciduous forest dominated by *Boswellia serrata* Roxb. ex Colebr., *Lagerstroemia parviflora* Roxb., *Wrightia tomentosa* R. and S. and *Anogeissus latifolia* Wall.; near Jhingurda (24° 10′ 20″ –20° 12′31″ N, and 82° 42′–82° 44′ 30″ E and 350-450 m altitude) in Madhya Pradesh, India. The climate is tropical monsoonal and the year can be divided into a cold winter (December-February), a hot summer (May-June), and a rainy season (July-September). Mean monthly minimum temperature within the annual cycle ranges from 6.4-28°C and mean monthly maximum from 20-42°C. The annual rainfall averages 934 mm, of which 795 mm occurs between late June-September. The soils are residual ultisols. The mine spoils are unconsolidated mixed overburden material with the degree of natural revegetation varying with age. Surface coal mining at Jhingurda Colliery was started in 1965.

An age series of coal mine spoils (5, 10, 12, 16 and 20 yr) and adjacent native forest sites were selected at Jhingurda Colliery, NCL, Singrauli, for the present study.

In July 1986 spoil samples were collected from the upper 10 cm layer from mine spoils of different ages and native forest, and were transported to the laboratory. A total of 117 polyethylene pots; each having approximately 1 kg of overburden material except for 39 pots which had one-fifth of native forest soil and four-fifth of overburden material, were prepard for each age of mine spoil. 39 pots for each spoil age received NPK fertilizer equivalent to 120 kg/ha N as urea, 60 kg/ha P as P_2O_5 (single super phosphate) and 60kg/ha K as K_2O (muriate of potash).

Thus each of the treatments were as follows :

— mine spoil alone of five different ages,

— mine spoil of five different ages+NPK,

— mine spoil of five different ages+forest soil.

Each treatment was replicated thrice.

Five seeds were dibbled at 1.5 cm depth in each pot. Plants were thinned to one per pot on the 15th day after seeding. Length of shoot was measured at one month interval for one year.

Following plant species were tried :

Tree-legumes : *Acacia catechu, Acacia nilotica, Albizia procera, Pongamia pinnata, Prosopis juliflora, Dichrostachys cinerea, Leucaena lencocephala.*

Leguminous forbs : *Desmanthus virgatus, Macroptelium abropurpureum, Clitorea ternatea, Stylosanthes hamata, Stylosanthes humilis.*

Grass : *Cenchrus ciliaris*

Results

Length of shoots in various treatments in pot culture experiments after one year growth are given in Table 1.

Analysis of variance indicated significant effects of the age of mine spoil (5, 10, 12, 16 and 20 yr old) and treatments (mine spoil alone, mine spoil+NPK fertilizer, and mine spoil+forest top soil mixture) on shoot growth for all plant species ($p<0.001$).

The treatment effects were further analysed through multiple range test (SPSS, 1985) (Tables 2 and 3). Significant difference in shoot growth was observed for NPK treated plants compared to those grown in mine spoil only and in mine spoil+forest soil (Table 2). Addition of forest soil showed significant effect only in three plant species (*Albizia procera, Desmanthus virgatus* and *Cenchrus ciliaris*) (Table 2).

Multiple range test indicated that the effect of spoil age on shoot growth was not significant in *Albizia procera* and *Desmanthus virgatus* (Table 3). Shoot growth in 20-yr old mine spoil was significantly higher compared to that in 5, 10, 12 and 16 yr old spoils in *Acacia catechu, Pongamia pinnata, Prosopis juliflora, M. atropururеum, Stylosanthes hamata* and *Cenchrus ciliaris*. In *Acacia nilotica, L. leucocephala* and *S humilis* shoot growth in 16 and 20-yr old spoils were significantly higher compared to 5, 10 and 12 yr old spoils, and shoot growth in 16 and 20-yr old spoils were not significantly different among themselves (Table 3).

Table 1

Shoot length of plants seeded in mine spoils of different ages in different treatments in laboratory conditions after one year.

Treatments	Mine spoil					Mine spoil+NPK					Mine spoil+Forest soil				
Spoil age (yr)	5	10	12	16	20	5	10	12	16	20	5	10	12	16	20
Acacia catechu	19	26	30	23	35	30	34	36	32	60	25	28	32	27	50
	±3.1	3.4	1.4	1.9	2.4	2.4	3.6	4.5	2.5	7.4	2.4	1.7	1.9	1.2	4.7
Acacia nilotica	51	58	54	71	80	72	82	76	100	120	60	69	67	96	100
	±2.5	4.8	2.8	4.0	4.3	1.6	0.9	2.5	10.3	1.6	5.9	4.5	5.3	5.7	6.2
Albizia procera	41	45	43	60	49	92	101	98	150	105	54	66	60	70	67
	±2.5	1.7	3.4	4.1	4.8	8.1	7.1	5.9	2.4	4.7	5.7	9.3	8.5	8.5	9.7
Dichrostachys cinerea	46	48	50	50	60	78	66	75	84	90	69	53	70	78	75
	±5.7	2.9	4.2	4.9	4.7	9.3	6.8	8.5	13.7	7.1	4.0	2.9	3.8	6.2	6.1
Desmanthus virgatus	65	76	74	80	85	93	105	100	116	120	78	92	90	96	98
	±2.1	4.1	4.1	1.9	3.3	3.7	2.1	3.3	3.4	7.4	3.4	5.7	3.8	6.6	5.7
Pongamia pinnata	45	50	48	60	68	68	72	69	74	79	48	56	50	66	72
	±2.1	3.3	2.1	4.2	3.8	2.5	1.9	3.7	1.2	4.8	5.0	6.8	2.4	3.4	4.6
Leucaena leucocephala	60	63	68	76	75	81	72	82	87	90	70	69	74	84	81
	±1.9	3.4	3.9	0.9	1.7	3.4	5.0	6.2	5.0	1.9	2.5	4.0	5.7	3.4	2.5
Prosopis juliflora	62	68	74	76	70	99	90	83	86	110	68	80	78	80	88
	±4.6	5.0	1.7	4.5	4.7	5.4	6.2	5.3	4.3	8.5	3.4	2.4	2.5	1.2	1.2
Clitoria ternatea	104	95	105	115	110	121	106	128	135	130	110	101	117	120	115
	±1.9	6.2	2.1	2.1	3.8	4.0	1.9	2.5	4.7	4.1	4.1	0.5	2.9	4.7	2.4
Macroptelium atropurpureum	78	84	100	95	120	104	101	120	120	140	84	93	116	102	134
	±3.4	4.1	6.2	6.2	1.9	11.1	4.5	1.9	2.1	2.8	2.6	5.7	6.8	4.3	3.4
Stylosanthes hamata	40	50	48	42	60	54	65	60	58	80	43	56	54	47	70
	±4.3	1.4	3.4	5.0	7.1	5.7	2.4	6.2	3.4	0.9	1.2	3.4	2.5	2.5	1.9
Stylosanthes humilis	35	45	41	38	55	44	64	50	47	76	38	54	46	42	65
	±1.7	4.5	1.7	5.0	2.9	1.9	5.7	3.3	3.4	2.5	3.3	4.1	5.0	6.2	3.3
Cenchrus ciliaris	23	25	24	27	40	49	55	53	60	80	40	52	42	54	56
	±0.9	2.1	2.5	1.6	4.1	2.5	4.2	3.4	5.2	3.8	2.4	5.0	0.9	4.0	5.0

Table 2

Effect of application of NPK and forest soil on shoot growth in mine spoil (values are maximum shoot length in cm averaged across spoil ages).

Species	Mine spoil	Mine spoil +NPK	Mine spoil+ forest soil
Acacia catechu	26.6^{a}	38.7	32.4^{a}
Acacia nilotica	62.8^{a}	90.0	77.6^{a}
Albizia procera	47.6	109.2	63.4
Dichrostachys cinerea	47.5	80.6^{a}	70.0^{a}
Leucaena leucocephala	68.4^{a}	82.4	74.4^{a}
Pongamia pinnata	54.2^{a}	72.4	58.2^{a}
Prosopis juliflora	78.0^{a}	105.1	92.6^{a}
Clitoria ternatea	105.8^{a}	124.0	112.6^{a}
Desmanthus virgatus	76.0	107.0	93.6
Macroptelium atropurpureum	95.4^{a}	118.6	105.8^{a}
Stylosanthes hamata	48.0^{a}	61.3	56.0^{a}
Stylosanthes humilis	42.8^{a}	56.2^{a}	47.9^{a}
Cenchrus ciliaris	27.8	59.4	48.8

Across row values suffixed with the same letter are not significantly different among themselves at HSD 5%.

Table 3

Effect of age of mine spoil on shoot growth (values are maximum shoot length in cm averaged across treatments).

Species	Spoil Age (Yr)				
	5	10	12	16	20
Acacia catechu	24.7^{a}	29.3^{a}	32.7^{a}	27.3^{a}	48.3
Acacia nilotica	6 .0^{a}	69.7^{a}	65.7^{a}	89.0^{b}	100.0^{b}
Albizia procera	—	—	—	—	—
Dichrostachys cinerea	64.3^{a}	55.7	65.0^{a}	70.7^{a}	75.0^{a}
Leucaena leucocephala	70.3^{a}	68.0^{a}	74.7^{a}	82.3^{b}	82.0^{b}
Pongamia pinnata	53.7^{a}	59.3^{a}	55.7^{a}	66.7^{a}	73.0
Prosopis juliflora	76.3^{a}	79.3^{a}	78.3^{a}	80.7^{a}	89.3
Clitoria ternatea	111.7^{a}	100.7^{a}	116.7^{b}	123.3^{b}	118.3^{b}
Desmanthus virgatus	—	—	—	—	—
Macroptelium atropurpureum	88.7^{a}	92.7^{a}	112.0^{b}	105.7^{b}	131.3
Stylosanthes hamata	45.7^{a}	57.0^{a}	54.0^{a}	49.0^{a}	70.0
Stylosanthes humilis	39.0^{a}	45.7	42.3^{a}	54.3^{b}	65.3
Cenchrus ciliaris	37.3^{a}	44.0^{a}	39.7^{a}	47.0^{a}	58.7

Across row values suffixed with the same letter are not significantly different among themselves at HSD 5%.

Among the two *Acacia* spp., *A. nilotica* showed higher shoot growth in mine spoil, mine spoil+NPK and mine spoil+forest soil mixture than *A. catechu* in all ages of mine spoils. *Stylosanthes hamata* showed better growth in all treatments than *S. humilis* (Table 1).

Discussion

Usually mine spoils are N and P deficient, therefore, several workers have found that NPK addition increased above-ground crop yield (Chichester and Hauser, 1984; Dancer and Jansen, 1981; Barker *et al.*, 1977). In the present study NPK additions showed significantly greater shoot growth as compared to mine spoil only and mine spoil+forest soil treatments. Mine spoil+forest soil treatment showed significant greater shoot growth only in three plant species. Forest soil is impoverished (Table 4) therefore, shoot growth response in majority of plant species was not greater after addition of forest soil to mine spoil compared to NPK treatment. Shoot growth in majority of plant species was higher in 20-yr old spoil than in 5, 10, 12 and 16-yr old spoils.

Table 4

Certain properties of the mine spoils and the native forest soil. Values are means ± 1 SE (Based on Srivastava et al., 1989).

Site	Total soil N (%)	Mineral N (µg g^{-1})	NaHCO$_3$-Pi (µg g^{-1})
Forest soil	0.291±0.002	16.4±0.1	15.0±1.1
Mine spoil (age in yr)			
5	0.068±0.002	5.8±0.2	5.0±0.5
10	0.074±0.005	7.6±0.3	7.3±0.6
12	0.077±0.005	7.9±0.2	7.0±0.7
16	0.082±0.002	9.9±0.2	8.4±0.7
20	0.086±0.004	15.6±0.2	8.9±0.9

In *Pongamia pinnata* increase in shoot growth due to NPK application was maximum (51 per cent) in 5-yr old spoil and minimum (16 per cent) in 20-yr old spoil. Similarly increase in shoot growth (33 per cent) due to NPK application was higher in *M. atropurpureum* in 5-yr old spoil compared to 20-yr old spoil (17 per cent). In *L. leucocephala* NPK addition showed 35 per cent increase in shoot growth in 5-yr old spoil and only 20 per cent increase in 20-yr old spoil. In *D. cinerea* increase in shoot growth was 70 and 50 per cent, respectively in 5 and 20-yr old spoils. This indicated that with increase in the age of mine spoil there was less effect of NPK addition on shoot growth. This apparently is due to enhanced nutrient content with age of the mine spoil (Table 4). Mineral N is the flush of available soil N to plants which varies annually and seasonally. More rapid increase in mineral N compared to total soil N from 16 to 20-yr old mine spoil (Table 4) was due to increase in biological establishment (Jha. 1990). In the present mine spoils, total soil N, mineral N, NaHCO$_3$-extractable Pi, and exchangeable K increased with age of mine spoil while exchangeable Na decreased with age (Jha, 1990). The recovery of total soil N in the present mine spoils during 20 years of spoil age was 0.0012 per cent per year (Srivastava *et al.*, 1989). Thus it may take about 200 years of natural succession for the total N pool to reach the level of native soil

Effect of application of NPK was greater in grass *C. ciliaris* compared to leguminous trees and forbs except for *A. procera*. Increase in shoot growth due to NPK fertilization ranged from 16-71% in leguminous species while it ranged from 100-122% in *C. ciliaris*. Berg (1972) measured a seven fold increase in grass yields and a six fold increase in herbaceous ground cover following nitrogen fertilization of gold tailing from telluride ores. A liner effect of NPK fertilizer on yield was obtained when NPK were applied at higher rates in Southern Ohio coalmine spoil (Sutton and Hall 1987). Redente *et al* (1984) observed that high rate of fertilizer (NP) applications resulted in significantly greater seeded grass production compared to unfertilized seeded grass production in drastically disturbed soils at Colorado. DePuit and Coenenberg (1979) reported increase in grass yield after fertilizer applications on reclaimed areas. Vegetation production on plots with applied P was 10-fold greater than on plots without fertilizer application at North Dakota mine spoils (Sandoval *et al.*, 1973).

In the present study the experiment showed that mine spoils were non-toxic and suitable, although sub-optimal medium, for plant growth. Native forest soil was impoverished, therefore, shoot growth in majority of plants was not greater after addition of forest soil to mine spoil compared to NPK treatment.

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SUMMARY

An age series of coal mine spoils (5, 10, 12, 16 and 20 yr) of Jhingurda colliery, Northern Coalfields Ltd., Singrauli were evaluated as a medium for plant growth. Thirteen plant species were seeded in mine spoil alone of five different ages, mine spoil of five different ages+NPK; and mine spoil of five different ages+forest soil. Shoot growth of seeded plant species was measured. The experiment showed that mine spoils were non-toxic and suitable, although sub-optimal medium, for plant growth. Growth performance was better in NPK treatment compared to as in addition of forest soil to mine spoils due to impoverished nature of forest soil. Effect of application of NPK was greater in grass compared to leguminous trees and forbs, generally. With increase in the age of mine spoil there was less effect of NPK addition on shoot growth due to increase in nutrient content with the age of mine spoil.

भारत के शुष्क उष्ण पर्यावरण में पादप वृद्धि कराने के माध्यम के रूप में कोयला खानों के छोड़े अवशेषों का मूल्यांकन

ए०के० झा

सारांश

झिंगरडा कोयला खदान, नार्दर्न कोलफील्ड लि०, सिंगरौली द्वारा छोड़ी गई कोयला खानों के अवशेषों की आयु श्रेणी (5, 10, 12, 16 और 20 वर्ष) का मूल्यांकन पादप वृद्धि कराने के माध्यम के रूप में किया। पांच विभिन्न आयु के खान अवशेष मात्र, पांच विभिन्न आयु के खान

अवशेष+नाइट्रोजन, फास्फोरस और पोटाश तथा पांच विभिन्न आयु के खान अवशेष व वन मृदा में 13 पादप जातियों के बीज बोए गए। बोई पादप जातियों की प्ररोह वृद्धि मापी गई। सपरीक्षण से पता लगा कि खनिज अवशेष विषैले नहीं व उपयुक्त, यद्यपि पादप वृद्धि के लिए अव-इष्ट माध्यम हैं। खनिज अवशेष में वन मृदा मिलाने की तुलना में नाइट्रोजन-फास्फोरस-पोटाश मिलाने के उपचार में वृद्धि सक्रियता अधिक अच्छी रही क्योंकि वन मृदा में पोष्याहार कम रह जाते हैं। सामान्यत: शिम्बिवर्गीय वृक्षों और शाककों के मुकाबले में घास पर नाइट्रोजन-फास्फोरस-पोटाश देने का प्रभाव अधिक पड़ा। खनिज अवशेष छोड़ने का समय बढ़ने के साथ प्ररोह वृद्धि पर नाइट्रोजन फास्फोरस-पोटाश देने का प्रभाव कम होता गया क्योंकि समय बढ़ने के साथ पोष्याहार तत्वों में वृद्धि होती जाती है।

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AUTECOLOGY OF *AILANTHUS GLANDULOSA* DESF. IN WESTERN HIMALAYAS

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Introduction

Ailanthus glandulosa Desf is a deciduous tree and belongs to family Simaroubaceae. It grows very fast and produces abundant root-suckers and therefore can be used to clothe barren and stony hills (Brandis, 1874). In temperate Zone of Himalayas it is noticed growing between 1500 to 1800 m above the mean sea level. It associates with *Populus ciliata* and forms a colony which helps in stabilizing the hill slopes (Mathur *et al.*, 1982). Informations on its morphological characters such as height, crown area, clean bole etc, seed germination, root characteristics including root suckers and propagation technique is not available therefore, attempts were made to study its autecology and have been reported.

Material and Methods

This study was carried out along NH-22 between Fagu and Shillaru where *A. glandulosa* occurs abundantly on both upper and lower sides of the road. It throws a lot of root suckers. *A. glandulosa* flowers in May-June and seed matures in November-December. Newly produced roots were dugout for three years from different localities in the study area at the time of commencement of growth in early spring Twenty two centimeters long freshly dug root pieces were planted in Shillaru nursery. Seven centimeters deep furrows were made 30 cm apart in nursery beds of 1 m^2 area and twenty two centimeters long roots cuttings were laid horizontally in these furrows keeping 10 cm distance between two pieces in a furrow. The root cuttings were covered by about five centimeters thick layer of soil. The beds were irrigated regularly. Seed germination was tested in nursery as well as in laboratory at different time intervals from the date of collection.

Eighty six plants of *A. glandulosa* were measured for different morphological characters and mean value of each character is presented in this communication. Five plants of different diameters were dug out carefully to measure root characteristics. Biomass of different plant parts was also measured of these five trees by adopting selective harvesting technique. Fresh weight of individual part of separate tree was measured in the field and composite samples were brought to laboratory for dry weight estimation. Propagation through stem/branch cuttings has also been tried in nursery.

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Result and Discussion

Biomass of different plant parts and morphological characters : Biomass of different diameter trees of *A. glandulosa* is presented in Table 1. Stem contributes maximum to the total biomass followed by root, leaves and branches in that order except that of tree of 16.2 cm diameter where branches contribution was more than leaves. Total biomass increased with the increase in diameter of the tree. The same trend was observed in *Eucalyptus tereticornis* where total biomass increased with increasing age and diameter of trees (Singh, 1982). On an average, stem contributes 39.2% to the total biomass while the average contribution of root, leaves and branches was 25.7%, 18.5% and 16.3% respectively.

Of eighty six trees studied, the minimum values of d b h, clean bole, trees height and crown area were 6.6 cm; 1 05 m; 4.3 m and 4.9 m^2 while the maximum values were 52.5 cm; 3.4 m; 14.0 m and 72.3 m^2. The average values of d.b.h, clean bole, tree height and crown area were recorded 21.28 ± 8.85 cm; 2.14 ± 0 52 m, 8 43 ± 1.97 m and 24.77 ± 14.90 m^2 respectively. *A. glandulosa* sprouts very well through root-suckers and forms a thick colony and checks erosion specially splash erosion. The ability of a plant species in checking splash erosion depends upon the crown area (Singh *et al.*, 1990). This species is very much suitable for soil conservation.

Root characteristics : Different root characters such as tap root length, number of lateral roots, average length of lateral roots,

Table 1

Biomass of different plant parts of Ailanthus glandulosa.

Plant No.	D.B.H (cm)	Biomass of different plant parts (kg/tree)				Total Biomass (Kg/tree)
		Stem	Branches	Leaves	Root	
1	16.2	20.5 (42.9)	9.7 (20.3)	7.3 (15.3)	10.2 (21.3)	47.7
2	25.4	23.0 (33.5)	11.5 (16.7)	14.6 (21.2)	19.5 (28.4)	68.6
3	29.9	27.2 (36.9)	11.3 (15.3)	14.9 (20.2)	20.2 (27.4)	73.6
4	36.6	42.0 (42.1)	14.2 (14.2)	17.5 (17.5)	26.0 (26.0)	99.7
5	46.1	47.3 (40.3)	17.5 (15.1)	21.3 (18.4)	29.5 (25.5)	115.6

Figures in ( ) are the percentage of that part in respect of total biomass.

diameter of lateral roots at 10.0 cm interval and average taper rate per 10 0 cm interval, are tabulated in Table 2. This table reveals that *A. glandulosa* has a well developed root system with a tap root which penetrates deep in the soil. Maximum root depth recorded was 205.0 centimeters. Number of lateral roots varied from six to nine and their lengths from 46.8 to 216.1 cm. On road sides cutting and landslips where roots of this tree get exposed, large number of root suckers sprouting up and colonise the landslips. The average taper rate at 10.0 cm interval decreases as the root length and diameter of trees increases (Table 2) which indicates that roots are stronger in old plants than younger ones. On an average the root of individual *A glandulosa* tree binds over an area of 3.11 m². Roots can increase the stability of slopes by anchoring a weak soil mass to fractures in bed rock, by crossing zones of weakness to more stable soil, and by strengthening soil with long fibrous binders (Mathur *et al.*, 1982, and Singh *et al.*, 1990).

Table 2

Root characteristics of Ailanthus glandulosa.

Plant No.	D.B.H. (cm)	Tap root length (cm)	No of lateral roots/ plant	Average length of lateral root/ plant (cm)	Spread of lateral root/ plant (m²)	Average of diameter of lateral root at root/plant 10 cm intervals	Average taper rate/ 10 cm
1	16.2	62.5	7	46.8	1.30	2.29; 1.30; 0.98; 0.80; 0.61; 0.41.	0.37
2	25.4	105.6	6	89.3	1.45	4 10; 3.18; 2.38; 1.78; 1.33; 0.98; 0.72; 0.63; 0.47; 0.31; 0.26.	0.35
3	29.9	165.2	8	139.5	4.20	4.82; 4.05; 4.00; 3.72; 3.20; 2.85; 2 58; 2.37; 2.18; 1.79; 0 94; 0.80; 0.59; 0 47; 0.32; 0.21.	0.30
4	36.6	190.7	6	172.5	3.60	4.92; 4.80; 4.75; 4.60; 4.42; 4.20; 3.99; 3.87; 3.57; 3 31; 3 13; 2.98; 2 45; 2.18; 1.75; 0 98; 0.78; 0.56; 0 36.	0 25
5	46.1	205.0	9	216.1	5.00	5.20; 4.91; 4.80; 4.65; 4 48; 4.32; 3.98; 3.31; 2.81; 2.42; 2.29; 1.93; 1.72; 1.35; 1.14; 1.12; 0 98; 0 71; 0.67; 0.60; 0.45; 0.35; 0 23.	0 22

Seed germination and stem cutting : A. glandulosa seeds remain viable for over one year period. Seeds collected in December, gave 86.00±3 60% and 84.33±5.04% germination in March the following year in laboratory and nursery respectively (Table 3). September sowing gave 64 00±10.58% and 54.33±7 57% germination in laboratory and nursery. *A. glandulosa* seed absorbs more water than its weight within 24 hours period of soaking which indicates that *A. glandulosa* seed has no seed coat dormancy.

Table 3

Germination behaviour of Ailanthus glandulosa seeds.

Conditions/Months	Germination (%)
In Laboratory	
March	86.00 ± 3 60
May	83 40 ± 4 87
September	64 00 ±10 58
In Nursery	
March	84.33 ± 5 04
May	70 66 ± 4.32
September	54 33 ± 7 57

± is the standard deviation of mean.

Twenty two centimeters long newly produced stem/branch cuttings were planted in nursery deds at monthly interval throughout the year. Beds were irrigated regularly but no root formation took place in these cuttings. It was noticed during this study that 20 to 30% cuttings planted in March and April, sprouted and new leaves appeared which dried up later as no root formation took place. This aspect needs further study in controlled environment.

Sprouting of root suckers : A. glandulosa reproduces abundantly through root suckers. The suckers spring from the roots which get exposed or injured. Twenty two centimeters long root cutting planted in nursery beds sprouted, the data is given in Table 4. On an average 65.81±5.43% sprouting of suckers was recorded in nursery conditions. Suckers generally appeared in cluster and recorded their presence at the cut ends of root segments. Singh and Kashayap (1982), have also studied suckers development in *Populus ciliata* root and concluded that the incised roots of *P. ciliata* have good suckering capacity. Normal roots of growing *A. glandulosa* do not produce suckers which may be due to the presence of auxin which

Table 4

Sprouting of root sucking in Ailanthus glandulosa

Years	Sprouting (%)
1980	66.66 ± 7.63
1981	60.00 ±13.22
1982	70.68 ± 8 66

± is the standard deviation of mean.

supresses suckering in such roots. Breaking down of the auxin in excised roots facilitates suckers production in *Populus tremuloides* (Schier, 1975). The results of present investigation get significant support from the results of *Populus ciliata* and *P. tremuloides*.

SUMMARY

The autecology of *Ailanthus glandulosa* Desf. in Western Himalayas was studied. Its biomass and root development was analysed. It is a good soil binding tree species and reproduces through seed and root suckers. Seed remains viable for over one year.

पश्चिमी हिमालय क्षेत्र में एलैन्थस ग्लेण्डुलोसा डेस्फे० की व्यक्ति-पारिस्थिकी

आर०पी० सिह, एम०के० गुप्त व प्रकाश चन्द्र

सारांश

पश्चिमी हिमालय प्रदेश में एलैन्थस ग्लैण्डुलोसा डेस्फे० की व्यक्ति-पारिस्थिकी का अध्ययन किया गया। इसके जैवपुंज और जड़ों के विकास का विश्लेषण किया गया। यह मिट्टी बाँधने वाली अच्छी वृक्ष जाति है तथा बीज और जड़वों से पुनरुत्पन्न हो जाती है। बीज एक वर्ष तक जीविष्णु बना रहता है।

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WOOD ANATOMY OF INDIAN SPECIES OF *MICHELIA* WITH PARTICULAR REFERENCE OF THEIR IDENTIFICATION

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Introduction

Michelia is one of the commercially imprortant genera of the family Magnoliaceae. The wood finds a variety of uses such as posts, boards, veneers, decorative fittings, manufacture of plywood and light construction work The timber is specified for ammunition boxes, plywood boxes, battens of internal fitting, jute bobbins, turnery articles, handles for brushes, decorative plywood and door, window and ventilater frames etc.

In India, *Michelia* is represented by 11 species. The woods of all the species are homogeneous in physical and gross anatomical features (Chowdhury and Ghosh, 1958) and are known as 'champ' in the trade (Anon, 1976). With a view to distinguish the different *Michelia* species for their effective utilisation, detailed anatomical studies have been undertaken on 8 species of *Michelia* available in the wood collection of Forest Research Institute, Dehra Dun. Anatomical characters such as shape, size and frequency of vessels, presence and absence of spirals, ray height and width, presence and absence of oil cells in the rays and shape of fibres as seen in cross section were taken into consideration for the separation of the species.

Material and Methods

The authentic samples of the following species available in the Wood collection (Xylarium) of the F.R I were taken for the present study.

M baillonii Finct and Gagnep.—DDw 7256 Assam.

M. champaca L.- DDw 5806 West Bengal, DDw 7265 West Bengal, DDw 7892 Bihar.

M. doltsopa DC.—DDw 60 0 West Bengal, DDw 8267 West Bengal.

M kisopa Ham. ex DC.- DDw 8155 U.P.

M mannii—DDw 7257 Assam, DDw 7488 Assam.

M nilagirica Zenk—DDw 6078 Tamil Nadu, DDw 6399 Tamil Nadu.

M. oblonga Wall. DDw 7411 Assam, DDw 7413 Assam, DDw 7514 Assam.

M. velutina DC.—DDw 3331 West Bengal, DDw 8290 West Bengal.

Cross, radial and tangential sections were prepared and stained with haematoxylin and safranin. The sections were mounted by following the usual laboratory procedure. For observations of crystals and silica, unstained sections were first bleached by sodium hypochlorite solution and then washed, dehydrated and mounted after treating with phenol crystals.

Table 1

Diagnostic anatomical features of Michelia species

Species	Acc. No.	Sp. gr.	Vessels										Fibres			Rays				Parenchyma		
			% Solitary	Radial multiples	Frequency per mm^2	Angular in cross section:	Oval to circular in cross section	Max. Tang. Diameter	Bars on perforation plate	Tyloses	Spirals	Silica (viterous)	Pits on radial walls	Circular to angular in cross section	Rectangular in cross section	Seriation	Max. width in µm	Max. height in µm	Oil cells	Diffuse	Concentric bands (Terminal)	Seriations
M. baillonii	7256		50—60	2 - 4	15—22	—	+	160	3 -6	+	—	+	+	+	—	1 - 4	55	800	+	+	+	2—6
M. champaca	5806		50	2 4	11 -17	—	+	128	2—8	+	—	+	+	±	+	1—4	65	800	+	+	+	4—1
	7265		60	2 4	25—35	—	+	130	2 —6	+	—	+	+	+	+	1 - 4	75	900	+	+	+	4 7
	7892		60	2—5	15—20	—	+	128	2—5	+	—	+	+	±	+	1—5	46	880	+	+	+	2—5
M. doltsopa	6000		60	2—8	30—45	+	—	80	5 -12	+	+	—	+	+	—	1- 4	65	650	—	+	+	3 6
	8267		50	2—7	30 · 50	+	—	65	5—15	+	+	—	+	+	—	1 4	60	900	—	+	+	2—5
M. kisopa	8155		30	2—10	40 · 80	+	—	95	2—11	+	+	+	+	+	—	1—3	44	800	—	+	+	2—5
M. manii	7257		50	2—4	14 -20	—	+	160	5—10	+	—	+	+	±	+	1—4	67	800	+	+	+	2 6
	7488		60	2—4	10 - 22	—	+	165	4 —7	+	—	+	+	±	+	1 - 4	48	960	+	+	+	3—6
M. nilagirica	6038		40	2 5	40—60	±	+	128	2 · 5	+	+	+	+	+	—	1—3	41	640	+	+	+	2—5
	6399		40	2—6	40—60	±	+	120	2 - 8	+	+	—	+	+	—	1—3	55	960	+	+	+	2—5
M. oblonga	7411		50	2 - 4	15—30	—	+	144	2—5	+	—	—	+	+	±	1—3	44	850	—	+	+	2 —5
	7413		40	2—7	18—30	—	+	144	2 - 5	+	+	—	+	+	±	1—4	62	850	—	+	+	2 - 6
	7514		60	2—4	30—35	—	+	112	2 · 5	+	+	—	+	+	±	1 · 4	52	850	—	+	+	2 —5
M. velutina	3331		40	2—4	30 - 50	+	—	80	5 - 9	+	+	±	+	+	+	1—3	52	850	—	—	+	3 - 10
	8290		60	2—6	30 - 50	+	—	65	2—9	+	+	±	+	+	+	1—3	48	850	—	—	+	3—10

The frequency (per mm^2) and size of vessels have been recorded from cross sections. The detailed anatomical observations have been presented in Table 1.

Observations and Discussion

From the samples and sections the following properties and characteristics were observed. The colour of wood varies from yellowish-white to olive-green or olive-brown. They are soft to moderately hard, light to moderately heavy and medium fine-textured. The woods are diffuse-porous with distinct growth rings. The vessels are small to moderately large, 15-60 per mm^2 in frequency, solitary or in short (Pl. 1, Fig.1) to long, radial multiples and clusters (Pl. 1, Figs 2, 3 and 4) with scalariform perforation, spiral thickening are present in some species (Pl. 2, Figs. 7 and 9), intervascular pitting is large and scalariform and the pits to rays and parenchyma are large and simple, unilaterally compound (Pl. 2, Fig. 8) tyloses are often present. The parenchyma is terminal 2-10 cells wide (Pl. 1, Fig. 1). The rays are 1-4 seriate composed of upright and procumbent and square cells, heterogeneous (Pl 2, Figs. 5 and 6) with 1-4 rows of upright and square cells. Oil cells are present in some species (Pl. 2, Figs 5, 6) and fibre wall 3-5μm thick. Crystals are absent. Silica is present in some species as lining the vessel walls and tyloses (Fig. 11).

Plate 1

Fig 1— *Michelia champaca* L. Cross section showing moderately large, vessels arranged solitary or in short radial mutiples and terminal band of parenchyma ×14.

Fig. 2— *M. doltsopa* DC. Cross section showing small to very small vessels arranged in short to long radiat multiples ×14.

Fig. 3— *M. kisopa* Ham ex DC. Cross section showing small to very small vessels arranged in radial multiples and clusters ×14.

Fig. 4 - *M. nilagirica* Cross section showing small to moderately large very numerous vessels arranged in short to long radial multiples and clusters ×14.

Plate 2

Fig. 5— *M. baillonii* Gagnep and Finet.— Radial section showing oil cells in rays and spirals in vessels ×80.

Fig. 6— *M. baillonii* Tang. Section ×80.

Fig. 7— *M. doltsopa* DC. Radial section showing tyloses and spirals in vessels ×80.

Fig. 8— *M doltsopa* DC. Radial section showing scalariform perforation and ray-vessel pitting ×80.

Fig. 9— Same Tang. Section ×80.

Fig. 10— *M. champaca* L. Radial section showing non-septate fibres with small bordered pitting.

Fig. 11— *M. kisopa* DC. Tang. section showing silicified tyloses.

Plate 1

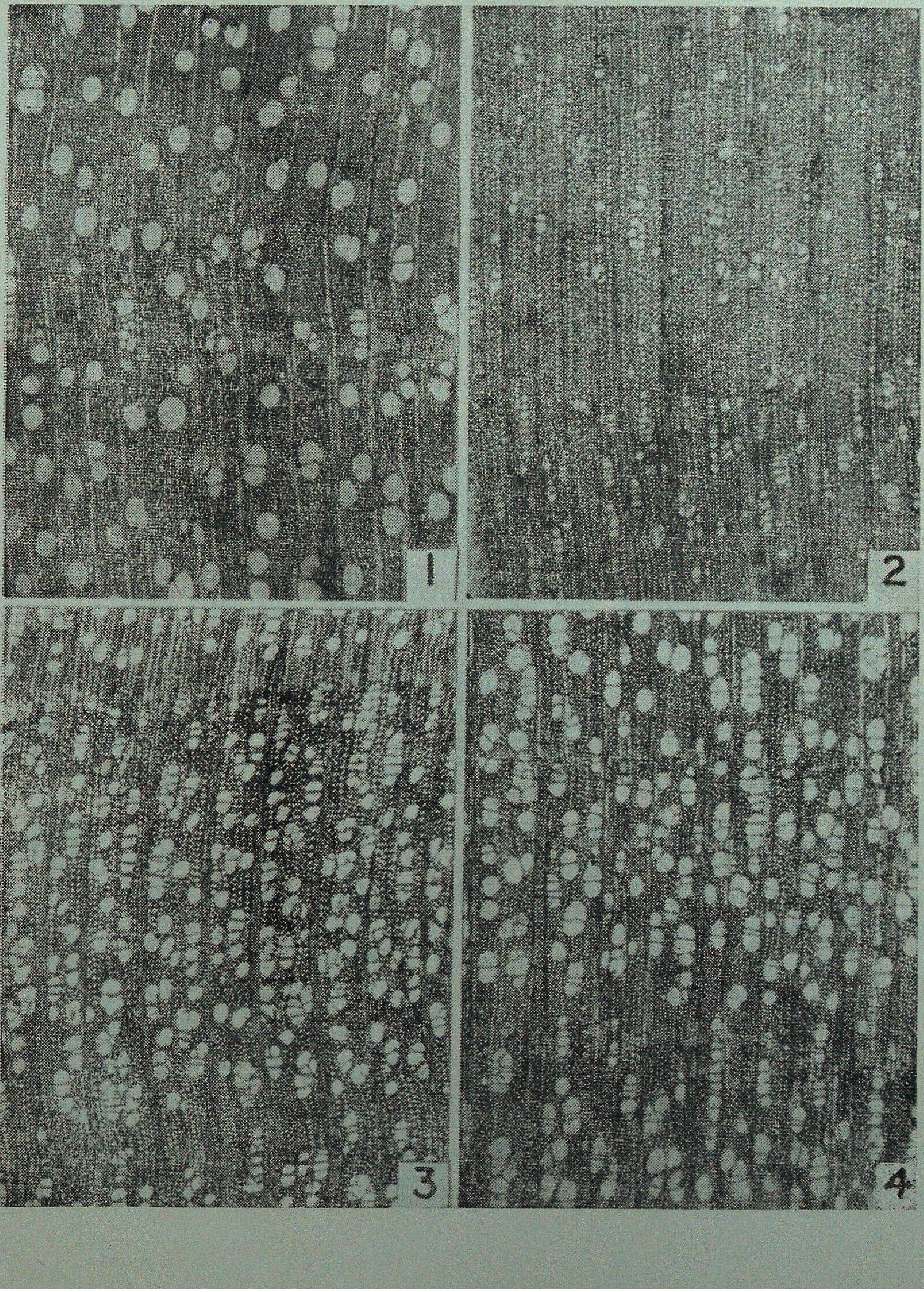
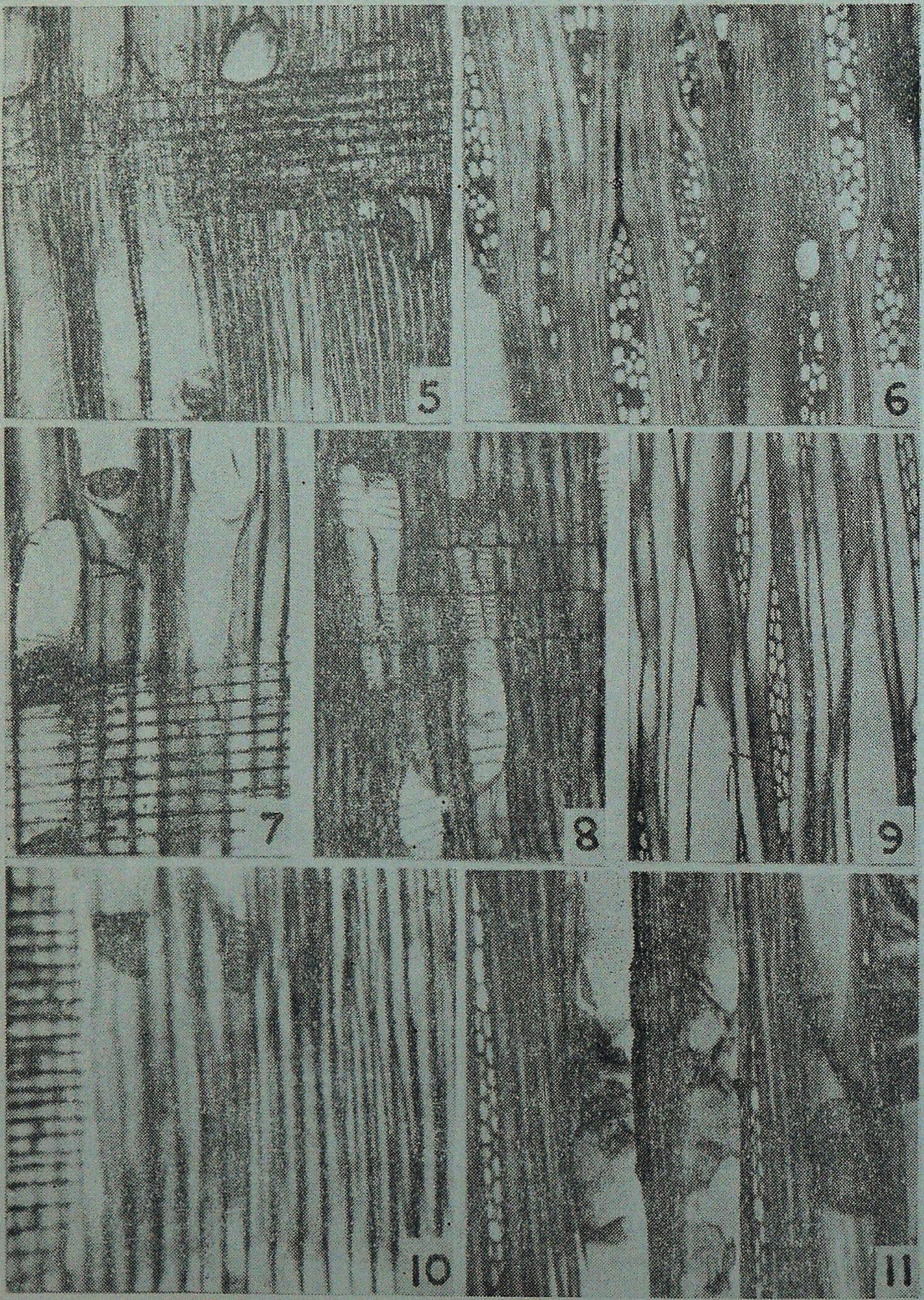


Plate 2



Pearson and Brown (1932) have given a key for identification of three commercial species by using vessel diameter, range of radial multiples, ray height and presence/absence of spiral thickening. The quantitative anatomical features recorded in the present study (Table 1) indicate that percentage of radial multiples, number of bars on scalariform perforation plate, ray width and height are of limited value in specific delimitation. The features such as frequency, shape and maximum tangential diameter of vessels, presence/absence of oil cells in rays and presence/absence of spirals in vessels are of diagnostic value in identification of different species studied. A tentative key has also been prepared and is given below :

Key to the Species

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1. (i) Max. tangential diameter of vessels $>100\mu m$—2
1. (ii) Max. tangential diameter of vessels $<\mu m$—5
2. (i) Oil cells in rays present—3
2. (ii) Oil cells in rays absent—*M. oblonga*
3. (i) Spirals in vessels present 4
3. (ii) Spirals in vessels absent—*M. champaca*, *M. manii*
4. (i) Frequency of vessels 40-60 per mm^2—*M. nilagirica*
4. (ii) Frequency of vessels 15-20 per mm^2—*M. bailonii*
5. (i) Frequency of vessels 50-80 per mm^2—*M. kisopa*
5. (ii) Frequency of vessels 30-50 per mm^2—6
6. (i) Silica (viterous) in vessels present—*M. lanuginosa*
6. (ii) Silica (viterous) in vessels absent—*M. excelsa*

SUMMARY

The wood structure of eight Indian species of *Michelia* have been studied in detail with a view of determining features of diagnostic value for their identification. The study indicate that various anatomical characters viz. frequency, size and shape of vessels, presence/absence of oil cells in rays and presence/absence of spirals in vessels are likely of value for their specific delimitation. A tentative key has also been given.

अभिज्ञान के विशेष संदर्भ में माइकेलिया प्रजाति की भारतीय वृक्ष जातियों का काष्ठ-शारीर

लक्ष्मी चौहान व आर० दयाल

साराँश

माइकेलिया प्रजाति की आठ भारतीय प्रकाष्ठ जातियों की काष्ठ संरचना का विस्तृत अध्ययन अभिज्ञान के पहचान परक मूल्यों हेतु संरचना विशिष्टताओं का निश्चय करने की दृष्टि से

किया गया। अध्ययन से पता चलता है कि वाहिनियों की बारबारता, आकार और रूप, रश्मियों में तेल कोशाओं का होना या न होना तथा वाहिनियों में वर्तुलता का होना या न होना उनका शिशिष्ट निश्चयन करने में संभावित मूल्य के हैं। परीक्षात्मक कुंजी भी दी गई है।

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FOREST, FODDER AND HILL AGRICULTURE : AN ANALYSIS OF INTER-DEPENDENCE IN UTTAR PRADESH HIMALAYAN REGION

DINESH PRATAP* AND M.H. QURESHI**

Interoduction

There has been a growing concern about ecology, scientific management of forests and development of resources along with fulfillment of local needs of the people in hill areas of the country. The emphasis, however, still remains on those aspects of management and conservation of forests which are related to commercial demand. There is scant consideration for local needs of the people. Moreover, there is paucity of information about quantum and pattern of forest use by local rural population. This paper is aimed to analyse pattern of requirement of fodder so essential to maintain the livestock for agricultural purposes in the hill region and the role of forest in this process.

Locale of Study

The hill region of Uttar Pradesh extends between 28′ 43′ 24″ and 31° 27′ 50″ North latitudes and 77° 34′ 27″ and 81° 02′ 22″ East longitudes covering an area of about 51,125 km². Administratively, the region is composed of five districts of Garhwal Division namely, Uttarkashi, Chamoli, Tehri Garhwal, Pauri Garhwal and Dehra Dun and three districts-Pithoragarh, Almora and Nainital of Kumaon Division (Fig. 1).

The economy of this region is predominantly agricultural. Only about 13 per cent of total area is under agriculture, and to very large extent depends on the forest for fuel and fodder.

Data base of Study

The primary information collected from 350 households of 21 sample villages spread over eight districts. The villages were selected from different altitudinal zones and population sizes to represent varied eco-climatic and socio-economic characteristics of the hill economy. In the selected 21 sample villages, 12 are of small size having population of less than 200 persons, 6 are medium sized with population between 200 and 500 persons and 3 are large size villages with over 500 persons. Altitudinally, 4 villages are situated at the height of less than 900 meters above mean sea level, 10 are situated in the zone of 900 to 1800 meters and 7 above 1800 meters (Fig. 2).

The cattle units maintained by villagers differ significantly in different altitudinal zones as well as in different population size villages. This variation is from 2.73 to 7.50 cattle units for the region as a whole but the highest number of cattle units is in the small villages and highest altitudinal zone (Table 1). The pattern as reflected from the table suggests that more livestock are being maintained where large areas are available

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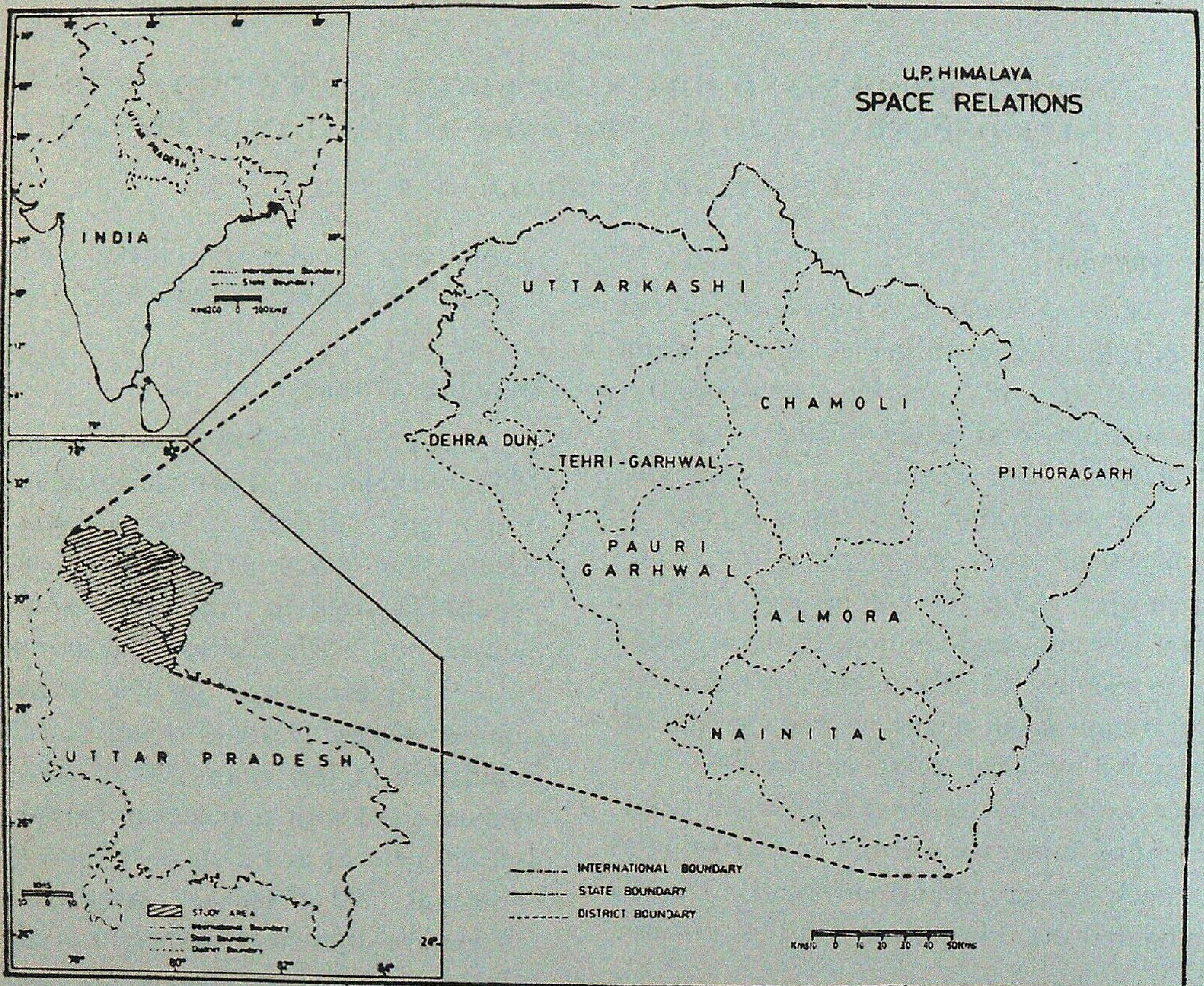
Fig. 1


U.P. HIMALAYA
SPACE RELATIONS
INDIA
UTTAR PRADESH
UTTARKASHI
CHAMOLI
DEHRA DUN
TEHRI-GARHWAL
PITHORAGARH
PAURI GARHWAL
ALMORA
NAINITAL
INTERNATIONAL BOUNDARY
STATE BOUNDARY
DISTRICT BOUNDARY
STUDY AREA

for grazing and where scope of agricultural expansion is limited making livestock rearing an important activity.

Livestock Rearing and Fodder Supply

The livestock rearing is an important sector, besides agriculture, in the hill economy of Uttar Pradesh. The livestock is reared for draught purposes, milk, cash income by selling sheep and goats, and also to provide manure for the fields. The quantity of fodder brought from the forest depends on the size of the stock, the nature of feeding and the quantity of fodder available from the agriculture. The animals are both, stallfed and grazed. Buffaloes are mostly stallfed while the sheep and goats are grazed. The cattle are largely fed through grazing.

The survey conducted shows that 94.15 per cent of buffaloes, 33.06 per cent of cows and 24.48 per cent of bullocks are stallfed. On the whole, among the bovines and draught animals, 48.19 per cent are stallfed. A sharp difference is seen in the proportion of animals grazed in different altitudes. This proportion is 30.76 per cent in the villages at lower altitudes but increases to 57.40 per cent in middle altitude zone and decreases to 49.56 per cent in the villages of higher altitudinal zone.

Fig. 2

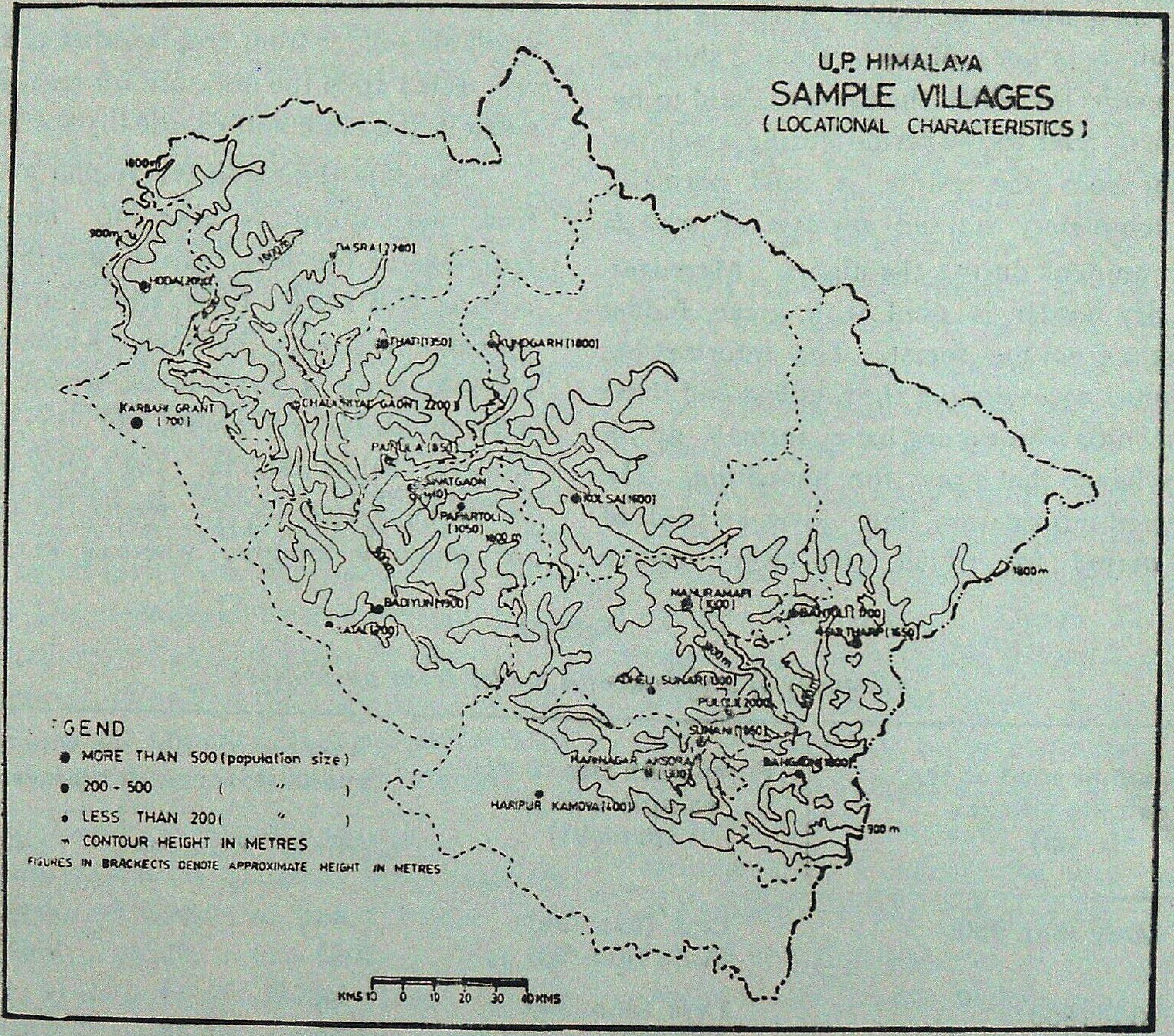

U.P. HIMALAYA
SAMPLE VILLAGES
(LOCATIONAL CHARACTERISTICS)
1800m
900m
1800m
DASRA (2200)
HODA (2000)
THATI (1350)
KUNDGARH (1800)
KARBARI GRANT (700)
CHAUNRIYAL GAON (2200)
PARULA (850)
SAMTGAON (1410)
PAPARTOLI (1050)
1800 m
900m
KOLSAI (1800)
BADIYUN (1900)
ATAL (200)
MANURAMARI (1500)
BANTOLI (1700)
SARTHARP (1650)
1800m
1800m
ADHEU SUNAR (1300)
PULCLIK (2000)
SUNANI (1850)
HARINAGAR AKSORA (1300)
BANGAON (1800)
HARIPUR KAMOVA (400)
900 m
GEND
● MORE THAN 500 (population size)
● 200 - 500 (")
• LESS THAN 200 (")
CONTOUR HEIGHT IN METRES
FIGURES IN BRACKECTS DENOTE APPROXIMATE HEIGHT IN METRES
KMS 10 0 10 20 30 40 KMS

Table 1

The average cattle units per sample household

Altitudinal zone of the sample villages (m)	Population size of the sample villages (persons)	Average cattle units		Total
		Garhwal	Kumaun	
Less than 900	Less than 200	5.00	5.91	5.30
	More than 500	2.73	—	2.73
900–1800	Less than 200	4.98	3.90	4.43
	200–500	5.58	5.16	5.37
	More than 500	3.71	3.52	3.59
More than 1800	Less than 200	8.23	6.54	7.50
	200–500	3.47	4.78	3.91
	Total (Average)	4.82	4.65	4.74

Fodder from Agriculture

The quantity of fodder available from agriculture is not sufficient. Table 2 showing the months for which the fodder is said to be sufficient refer to the period during which the fodder from crop residue is used normally for completely stallfed animals as well as other animals during the nights. Moreover, this dry fodder is used with green fodder brought from the forest. The information, compiled by excluding the landless and those households who do not have animals at all or exchange the straw for ploughing. The collected information thus, gives an idea of the period for which the crop residue supplements the fodder from the forest. Lastly, it should be understood that if the available fodder from crop-residue is exclusively relied upon the duration for its adequacy given in the table will drastically scale down.

The data show that the fodder available from agriculture is able to meet the requirement for less than 6 months. The adequacy of fodder from agriculture shows regional variation between Kumaon and Garhwal while it is still more pronounced in different altitudinal zones. In the villages situated below 900 m, the crop-residue-fodder/cultivated fodder meets the demand for about 9 months, whereas in villages

Table 2

Adequacy of supplemental fodder from agriculture

Altitudinal zone of the sample villages (m)	Population size of the sample villages (persons)	Average months for which it is available for each household in			
		Garhwal	Kumaon	Total	
More than 900	Less than 200	7.46	9.98	8.35	8.90
	More than 500	9.45	—	9.45	
900-1800	Less than 200	2.96	3.37	3.17	5.30
	200-500	4.86	6.48	5.70	
	More than 500	4.71	6.48	5.70	
More than 1800	Less than 200	2.97	5.03	3.87	4.18
	200–500	4.17	5.40	4.59	
	Total (Average)	5.04	5.96	5.45	

Adequacy of Fodder from Agriculture

Average for the villages with population size	Months
Less than 200	4.54
200-504	5.27
More than 500	6.59

situated between 900-1800 m, this demand is met for 5 months and 10 days and in villages above 1800 m it is adequate only for about 4 months. Taking the population size as the criteria for looking at role of crop-residue as fodder source, the situation is more favourable for larger villages. In these villages, crop-residue is sufficient for six and half months and in medium size villages only for five and a quarter months. One reason for higher availability of fodder from agriculture in lower elevations and large villages is the cultivation of fodder crops. Additionally, more fodder is obtained through different practices of harvesting and threshing. It was also noted earlier that the number of cattle units per household is less in the larger villages and villages at lower elevations. It is however, clear that only limited quantity of fodder is obtained from agriculture and thus farmer's great dependence on forest.

Green Fodder consumption pattern

Varying estimates have been made for the required/consumed green fodder from the forest. While in one study, 5.51 kg per cattle unit/day of fodder (dry matter) excluding the crop residue, has been estimated as the requirement, in another study the total aboveground phytomass consumed per cattle unit/day is estimated to be 26.8 kg, which is in addition to usual grazing. In the present study though the extent of grazing and the quantity of grass grazed could not be estimated, yet the estimation of quantity of green fodder required has been made. The time spent in collection of this fodder and the distance covered in each trip have also been estimated. These parameters define the people's involvement in making the arrangement of fodder from the forests.

Table 3 shows the green fodder consumption per cattle unit and its variations. This green fodder consumption includes the quantity consumed by the grazing and partly grazing animals. It should, therefore, be understood that the total requirement of fodder per stallfed animal will be much higher. The consumption of green fodder for the region as a whole is around 8.07 kg/cattle unit per day. It varies between 3.80 kg and 11.67 kg in different sample villages. The average variation is from 5.03 kg in small villages at an altitude of less than 900 m, to 10.89 kg in a large village at the same altitude. It is perhaps the extreme proximity of the forest to this particular village (Karbarigrant, Dehra Dun) that highest quantity of green fodder is consumed here. The general trend indicates that quantity of green fodder consumed is the lowest in the villages situated at the lower altitudes and it increases with increase in altitude. This reflects the fact that the availability of dry fodder from the agriculture in higher altitudes is restricted and consequently there is higher dependence on forests. A discernible difference in per cattle unit consumption of green fodder emerges in case of Garhwal and Kumaon. While in Garhwal the average consumption is 8 92 kg, in Kumaon it is 6 95 kg per cattle unit/day. One obvious reason which can be ascribed to this difference is the larger contribution of fodder from agriculture in Kumaon region. Secondly, the proportion of cattle sent for grazing is also higher in case of Kumaon as compared to Garhwal. Altitudinally, the highest green fodder consumption is reported at higher elevations in Garhwal but in Kumaon the consumption is more in middle altitudes. The size of the

Table 3

Quantity of green fodder consumed

Altitudinal zone of the sample villages (m)	Population size of the sample villages (persons)	Average per cattle unit per day (kg)		
		Garhwal	Kumaun	Whole Region (Average)
Less than 900	Less than 200	5.75	3.80	5.03
	More than 500	10.89	—	10.89
900-1800	Less than 200	10.48	8.36	9.52
	200-500	4.61	7.56	6.03
	More than 500	8.75	7.92	8.27
More than 1800	Less than 200	11.14	5.86	9.18
	200-500	11.67	5.83	9.29
	Total (Average)	8.92	6.95	8.07

Quantity of green fodder consumed

(Data aggregated according to altitudinal zone and population size of sample villages)

Altitudinal zone of the sample villages (m)	Green fodder consumption (Average per cattle unit/day)	Population size of the sample villages (persons)	Green fodder consumption (Average per cattle unit/day)
Less than	7.37	Less than 200	8.48
900-1800	7.47	200-500	7.00
More than 1800	9.21	More than 500	8.79

settlements does not show any marked influence on the green fodder consumption pattern. Nevertheless, small variations exist and the highest quantity of green fodder consumption per cattle unit is discernible in large size villages.

The time spent and distance covered in collection of fodder from the forest

The time spent in collection of fodder from the forest has been measured in hours for one particular trip and the number of days in a year when such trips are made. In calculating the time only that period has been taken into account which is spent only for fodder collection from the forest. The care has been taken to exclude those households which do not have animals and do not go to the forest for collection of fodder. There are 26 such households out of 350 sample households. There are another 31 households which do not visit the forest for fodder purposes Among these 20 are from Garhwal and 11 from Kumaon region. Most of these households belong to the two villages of Karbarigrant (Dehra Dun) and Haripur Kamova (Nainital) situated below 900 m, with good agricultural production, fulfilling most of the needs of fodder from crop residue.

The average time spent in collection of fodder is about four hours in a single trip and these trips are made, on an average, for 215 days in a year (Table 4). The average distance covered is 3.70 kms both ways

Table 4

Time spent in collection of green fodder from forest

Altitudinal zone of the sample villages (m)	Population size of the sample villages (persons)	Average time spent by a household member					
		Hrs/day/trip			Days/year		
		Garhwal	Kumaon	Total (Av.)	Garhwal	Kumaon	Total (Av.)
Less than 900	Less than 200	3 67	3.50	3.64	176	60	163
	More than 500	3 42	—	3.42	168	—	168
900–1800	Less than 200	3.00	3.07	3.03	289	195	242
	200 500	3.05	4 82	3 96	223	243	233
	More than 500	4 92	4.35	4.59	322	165	229
More than 1800	Less than 200	4.90	3 83	4.42	310	128	228
	200–500	3 56	3 67	3.60	144	160	149
	Total (Average)	3.92	4.16	4 02	245	178	215

Average time spent in collection of green fodder

Altitudinal zone of the sample villages (m)	Time spent		Population size of the sample villages (persons)	Time spent	
	Hr/day/trip	Day/year		Hr/day/trip	Days/year
Less than 900	3.55	165	Less than 200	3.87	221
900–1800	4.09	233	200–500	3 83	203
More than 1800	4.08	196	More than 500	4 44	221

(Table 5). There are large variations in different regions in time spent and distance covered in bringing fodder from the forest. In case of Garhwal, a single trip can take 3 hours to 5 hours in different altitudes. In Kumaon the average time taken for a single trip is more than 4 hours. Differences also exist in number of days for which a farmer has to go to the forest to collect fodder. In Garhwal, one household member has to go to the forest for as many as 245 days whereas in Kumaon one has to go for 178 days. It is, however, revealed that the people have to cover 4.40 km in a single trip in Kumaon while in Garhwal this distance is 3.12 kilometres. The analysis brings out the fact that in Garhwal region a household member spends comparatively more days in bringing the fodder from a lesser distance by spending less time in each trip. It can be argued that in case of Kumaon, the lesser number of cattle units per household require less quantity of green fodder as agriculture contributes a larger share of crop-residue. As a result a farmer has to go to the forest for less number of days but generally covers large distance and spends more time in each trip.

Table 5

Distance covered in collecting the fodder from forest

Altitudinal zone of the sample villages (m)	Population size of the sample villages (persons)	Average distance covered by a household member (kms./trip)		
		Garhwal	Kumaon	Total (Average)
Less than 900	Less than 200	2.07	4.00	2.29
	More than 500	2.29	—	2.29
900—1800	Less than 200	2.50	4.76	3.63
	200—500	2.55	3.68	3.13
	More than 500	3.94	5.42	4.82
More than 1800	Less than 200	3.88	3.44	3.68
	200—500	3.27	3.83	3.46
	Total (Average)	3.12	4.40	3.70

Average distance covered per trip

Altitudinal zone of the sample villages (m)	Km/trip	Population size of the sample villages (persons)	Km/trip
Less than 900	2.29	Less than 200	3.43
900—1800	4.00	200—500	3.25
More than 1800	3.59	More than 500	4.48

In the villages situated above 1800 m, the average number of trips made in a year are 196 and 3.59 km is to be covered in each trip and 4 hrs. are to be spent to bring the green fodder from the forest. But the problem is most acute in the villages between 900 and 1800 m altitudes where a farmer has to spend 4.09 hrs. per trip, covers 4.00 km of distance for 233 days in a year. Population-wise, a household member in the medium size village makes the least number of trips to the forest for fodder, covers the least distance and takes the least time in each trip.

Contribution of Forest in Fodder needs

The role of forest is very crucial for the success of livestock based agricultural economy of the hill region, due to large scale dependence of hill farmer on forest for fodder. It has been estimated that 71 to 87 per cent of the fodder is extracted from nearby forests by cutting floor vegetation and lopping trees for leaves and grazing It has also been shown that 4 to 8 hectare of mixed pasture is required to support one mature animal.

Forest serve as source of fodder, in varying degrees for 83.71 per cent of the households (Table 6). It is revealed that 56.85 per cent of the total households meet more than 50 per cent of their fodder requirements from the forests whereas in case of 21.14 per cent of the households this dependence is for more than 75 per cent of the total requirement. Another 26.86 per cent of the households obtain less than 50 per cent of their need from the forests. It has been observed that the dependence on forest for fodder requirement increases with the increase in the altitude. While 47.27 per cent of the households below 900 m altitude do not get any support from forest in respect of fodder, this proportion decreases to 9.18 per cent of households in the altitudinal zone of above 1800 m where 26 53 per cent of the households obtain more than 75 per cent of the fodder from the forest. In case of middle altitudes, about 70 per cent of the households meet more than 50 per cent of their fodder requirement from the forest. The size of the settlement also shows a relationship with the dependence on forests for fulfilling the fodder needs. In small size settlements, higher proportion of rural households depend for fodder on the forest as compared to their counterparts in larger settlements (Table 6). It is, infact, in the middle altitude, where largest proportion of the households show greater dependence. The extent of contribution of the forests in meeting the fodder needs varies between Kumaon and Garhwal regions. While the majority (above 50%) in both the areas, collect more than 50 per cent of the fodder requirements from the forest, the proportion of households collecting 75 per cent and more, is higher in Garhwal (31.28%) as compared to Kumaon (8.38). A significant conclusion of the present study is that fodder from the forest is not easily available even in the interior areas of the region. It was also noted during the field survey that increased pressure on forest has resulted in its degradation. After leaves and twigs are lopped off. large branches are chopped with a heavy cutting tool by women and small children damaging young plants. This accentuates forest degradation forcing the hill people to spend more time and walk longer distance to collect the required quantity of green fodder.

Table 6

Contribution of forest in fodder needs (Total Hill region)

Altitudinal zone of the sample villages (m)	Population size of the sample villages (persons)	Distribution of households according to degree of dependence (%)			
		Nil	Less than 50	5 -75	More than 75
Less than 900	Less than 200	29.17	41.67	25.00	4.16
	More than 500	61.29	38 71	0.00	0 00
900 1800	Less than 200	9.09	9.09	48.49	33.33
	200—500	11.11	22.22	50.00	16.67
	More than 500	11.96	18.48	43.48	26.08
More than	Less than 200	5.36	35.71	23.21	35.71
	200 500	14 29	38.09	33 33	14 29
	Total (Average)	16.29	26.86	35.71	21 14

Contribution of forest in fodder needs (Aggregated)

Altitudinal zone of the sample villages (m)	Distribution of households according to degree of dependence (%)			
Less than 900	47.27	40.00	10 91	1.82
900 -1800	11.17	18 27	46.70	23.86
More than 1800	9.18	36 73	27.55	26.53
Population size of the sample villages (persons)				
Less than 200	11.50	29.20	30.97	28 33
200—500	12.28	28.07	43.86	15.79
More than 500	24 39	23.58	32.58	19.51

SUMMARY

Forests as source of fodder, fuel and timber, not only affect the economic activity of the people in the hill region but play a dominant role in shaping their social and cultural life. The livestock which is so essential for the hill agriculture can not be maintained without the fodder coming from forest. The quantity of the fodder brought from the forest depends on the size of the stock, the nature of feeding and the quantity of the fodder available from the agriculture.

Forests serve as source of fodder, in varying degrees for 83.71% of the households in U.P. Himalayan region. It is also observed that the dependence on forest for fodder requirement increases with increase in the altitude On the whole above 50% of the households collect more than 50% of their fodder requirement from the forest. This work is invariably done by women who on an average spend 215 days in a year to fulfill the fodder need of a single household.

वन, चारा और पर्वतीय खेती—उत्तर प्रदेश के हिमालय क्षेत्र में इनकी पारस्परिक निर्भरता का विश्लेषण

दिनेश प्रताप व एम०एच० कुरैशी

साराँश

चारा, ईंधन और प्रकाष्ठ के स्रोत रूप में वन पर्वतीय क्षेत्र के लोगों के आर्थिक जीवन को ही प्रभावित नहीं करते बल्कि वे उनके सामाजिक एवं सांस्कृतिक जीवन में भी प्रभावकारी भूमिका निभाते हैं। ढोर-डगर जो पर्वतीय खेती के लिए एकदम अनिवार्य हैं, चारे के बिना रखे ही नहीं जा सकते जो वन से ही प्राप्त होता है। वनों से लाए जाने वाले चारे की मात्रा ढोर-डंगरों की सख्या, चारे की किस्म और स्वय खेती से प्राप्त होने वाले चारे की मात्रा पर निर्भर है।

उत्तर प्रदेश के पहाड़ी क्षेत्र में रहने वाले परिवारों में कमोबेश 83.17% परिवारों के लिए वन चारा प्रदान करने के स्रोत हैं। यह भी देखने में आया है कि चारे की जरूरतों के लिए वनों पर निर्भरता क्षेत्र की ऊचाई बढ़ने के साथ-साथ बढ़नी जाती है। कुल मिलाकर 50% से अधिक परिवार अपने चारे की जरूरतों का 50% से अधिक भाग वनों से लेते हैं। यह कार्य अनिवार्य रूप से वहाँ स्त्रियाँ ही करती हैं जो औसतन वर्ष में अपने 215 दिन एक परिवार की चारा सबधी जरूरतें पूरी करने के लिए लगाती हैं।

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A REVIEW OF THE SUITABILITY OF SOME COMMONLY OCCURRING GRASSES OF U.P. FOR THE PRODUCTION OF BLEACHABLE-GRADE PULPS

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Introduction

Grasses have been used for papermaking since ancient times. However, with the exception of sabai grass, no other grass has been commercially used for papermaking in India. There are several reasons for this. Although the chemical composition and morphological characteristics of several grass species have established their suitability for papermaking, but the commercial use of individual grass species could not be implemented in the paper mills since the grass species generally occur in mixture and extraction of single species is uneconomical. Keeping this in view investigations on mixtures of grasses were carried out and several mixtures were found suitable for papermaking.

This paper deals with the results of investigations carried out at Forest Research Institute, Dehra Dun and provides a comparative data on the chemical composition, fibre dimensions and papermaking characteristics of some commonly occurring grasses of U.P.

Investigations carried out at F.R.I. on grasses grown in U.P.

Considerable work on the utilization of forest grasses for papermaking has been carried out. The list of common grass species found suitable (Bhat and Roy, 1952; Bhat and Karnik, 1952; Bhat and Virmani, 1952; Bhat and Jaspal, 1959; Anon, 1958; Bhat *et al.*, 1960) for papermaking along with their local names and distribution has been given in Table 1.

The proximate chemical analysis and average fibre dimensions of above grasses have been recorded in Table 2.

The results recorded in Table 2 indicate that the chemical composition of all the grasses is in general comparable with sabai grass. As expected, ash content is higher in all the grasses (4.8% to 7.5%) except in *S. munja* (2.3%) and *P. karka* (3.09%). Cellulose, lignin and pentosan contents vary from 45.8% to 58.2%, 20.5% to 31.4% and 16.9% to 25.4% respectively. In case of sabai grass the values are 54.5%, 22% and 23.9% respectively. This indicates that all the grasses can be considered, as potential raw materials for papermaking.

The fibre length of the grasses at Sl. Nos. 4-7 (Table 2) is shorter than sabai grass and varies from 1.10 mm to 1.26 mm. However, the fibre length of *T. arundinacea* (2.88 mm) and *S. munja* (2.06 mm) is comparable with sabai grass (2.08 mm).

Table 1

List of grass species found suitable for writing/printing papers

Botanical name of species	Local Name	Distribution
Eulaliopsis binata	Sabai, Bhabar	Dehradun, Jaunsar, Garhwal, Nainital, Kheri, Haldwani, Saharanpur.
Themeda arundinacea	Ulla, Sarkhara	Jaunsar, Mussoorie, Dehradun, Kheri, Lansdown.
Saccharum munja	Munj, Seritha, Patwar, Kana	Dehradun, Kheri, Saharanpur, Gonda, Pilibhit.
Heteropogon contortus	Kusal, Kuneria, Shora, Sarwala	All over U.P.
Vetiveria zizanioides	Pani, Seenk	Dehradun, Gonda, Kheri, Ramnagar, Etawah, Pilibhit, Gorakhpur.
Phragmites karka	Bansi	Dehradun, Pilibhit, Saharanpur.
*Imperata cylindrica**	Siru, Sirhu	Jaunsar, Gonda, Dehradun, Kheri, Ramnagar, North Garhwal, Saharanpur.
*Saccharum spontaneum**	Kans, Khus, Khagar	Mussoorie, Dehradun, Kheri, Ramnagar, Bahraich, Ranikhet.

* Used in mixture with other grasses

Table 2

Fibre dimensions and proximate chemical analysis of grasses

Botanical name of species	Average fibre length (mm)	Average fibre diameter (mm)	Ash (%)	Cellulose (%)	Lignin (%)	Pentosans (%)
Eulaliopsis binata	2.08	0.009	6.0	54.5	22.0	23.9
Themeda arundinacea	2.88	0.016	7.4	54.5	31.4	22.0
Saccharum munja	2.06	0.015	2.3	58.2	20.5	23.7
Heteropogon contortus	1.10	0.010	7.5	52.1	27.3	16.9
Vetiveria zizanioides	1.20	0.008	5.7	45.8	25.8	25.5
Phragmites karka	1.20	0.011	3.09	55.2	25.7	22.4
Imperata cylindrica	1.26	0.010	4.8	50.1	24.3	19.5

Laboratory Pulping

Grasses were pulped by the soda process under varying conditions of temperature, time and concentration of chemicals. Bleaching of the pulps was carried out in single stage using calcium hypochlorite. The sheets were conditioned at 65 per cent R.H. and 25°C temperature and tested for their strength properties and brightness. The digestion conditions, bleached pulp yield and physical strength properties of paper are recorded in Table 3. The results recorded in Table 3 indicate that bleached pulps in satisfactory yield (31.7% to 48.2%) could be obtained from most of the grasses as compared to sabai grass (40.9% yield). The physical strength properties of the grasses are in general reasonably good though lower in some properties than sabai grass. Breaking length, tear factor and burst factor of grasses varies from 6,330 m to 10,670 m; 65.7 to 86.9 and 36.1 to 54.0 respectively. In case of sabai grass, the falues are 9,840 m, 123.0 and 63.9 respectively.

Table 3

Digestion conditions, yield and strength properties of grass pulps for writing/printing paper

Botanical name of species	Total alkali as NaOH (%)	Digestion temperature (°C)	Digestion period (hrs)	Bleached pulp yield (%)	Breaking length (m)	Stretch (%)	Burst factor	Tear factor	Brightness MgO=100
Eulaliopsis binata	17.0	1535		40.9	9840	4.4	63.9	123.0	72
Themeda arundinacea	17.0	142	6	35.8	8090	4.6	48.9	86.9	—
Saccharum munja	19.0	153	6	48.2	6330	—	54.0	69.9	—
Heteropogon contortus	20.0	153	6	31.7	7900	4.9	48.6	74.7	71
Vetiveria zizanioides	17.5	162 for first 2 hrs & 153 for remaining period	5	35.3	10670	3.8	50.7	65.7	—
Phragmites karka	22.0	153	6	40.0	6500	3.8	36.1	76.2	—

Pulping of mixture of grasses

Although on the pilot plant of F.R I. a few individual grass species have been found suitable for papermaking but, for commercial production, these species are not available in sufficient quantities. Hence, pilot plant investigations (Guha *et al.*, 1964 and 1966) on mixtures of grasses were undertaken and encouraging results were obtained. The results of pilot plant trials obtained from mixtures of U.P. grasses are recorded in Table 4.

From Table 4, it is obvious that though properties of paper prepared from mixture of species are some what inferior to those paper made from single grass species (Table 3); bleached pulps in satisfactory yield and strength properties can be made from mixture of grasses containing *Imperata cylindrica*, *Themeda arundinacea* and *Saccharum spontaneum* obtained from Haldwani, U P. and mixture of grasses consisting of *Saccharum spontaneum*, *Saccharum munja*, *Imperata cylindrica* and *Vetiveria zizanioides* obtained from Bijnor, U.P.

Table 4

Pilot plant digestions and strength properties of writing/printing paper from mixture of grasses

Composition of grasses	Digestion conditions and yield					Strength properties		
	Total alkali as NaOH (%)	Digestion temp (°C)	Digestion period (hrs)	Bleach consumption as available chlorine (%)	Bleached yield* (%)	Breaking length (m)	Burst factor	Tear factor
(a) *Imperata cylindrica* (b) *Themeda arundinacea* (c) *Saccharum spontaneum*	19	153	6	8	35.6	3880	17.5	70.0
(a) *Saccharum spontaneum* (b) *Saccharum munja* (c) *Imperata cylindrica* (d) *Vetiveria zizanioides*	17	153	6	5.6	34.6	4520	19.3	58.5

* The percentage is expressed on the basis of o.d. raw material.

SUMMARY

Investigations carried out at F.R.I. on the production of bleachable grade pulps suitable for cultural papers from some commonly occurring grass species of U.P. have been described. The results have been summarized in terms of chemical composition, fibre dimensions and physical strength properties of pulps under optimum conditions. The results of pilot plant investigations carried out on mixture of grasses suitable for papermaking have also been included.

उत्तर प्रदेश में आमतौर से पाई जाने वाली कुछ घासों से विरजनीय ग्रेड की लुगदी बनाने को उपयुक्तता की समोक्षा

रीता धवन, बी०जी० करीरा व जी०एम० माथुर

साराँश

इस अभिपत्र में उत्तर प्रदेश में आमतौर से पाई जाने वाली कुछ जातियों की घासों से कागज़ बनाने की उपयुक्त विरजनीय ग्रेड की लुगदी बनाने के वन अनुसंधान संस्थान में किए गए अन्वेषणों का वर्णन दिया गया है। परिणामों को रासायनिक गठन, रेशे की लम्बाई और अनुकूलतम दशाओं में लुगदी का भौतिक शक्ति विशिष्टताओं के रूप में दर्शाया गया है। कागज़ बनाने के लिए उपयुक्त घासों के मिश्रणों पर किए गए दिग्दर्शी संयन्त्र अन्वेषणों के परिणाम भी इसमें सम्मिलित किए गए हैं।

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MEAN ANNUAL INCREMENT IN THE FORESTS OF GARHWAL HIMALAYAS RELATED WITH SOIL AND GROUND LITTER PROPERTIES

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Introduction

Site factors are important determinants of forest productivity within a climatic region and physiographic stratum with soil being the major site component. Ralston (1964) and Carmean (1975) while reviewing research in North America on soil factors vis-a-vis site productivity concluded that the factors responsible for controlling the productivity of forests were the moisture, nutrients and aeration, and when other site factors kept uniform then soil nutrient level is more important (Moller, 1974; Pritchett and Gooding, 1975; Waring, 1973). The character of the forest floor, influencing many soil properties was also reported to be connected with the growth and development of forest stands since controls properties of organic matter which in turn regulate the regeneration of trees (Mathur and Bhatnagar, 1964). George (1977) and Negi (1984) studied the forest productivity vis-a-vis soil nutrients in the tropical and man-made forests but no such work is reported for the forests of the temperate regions particularly Garhwal Himalayas which are otherwise very important from management point of view. The present study which deals with the mean annual increment in these forests of deodar, chir and oak forests as related with soil properties and litter composition is an endevour in this direction.

Site

The area under investigation lies in the Dhanaulti Block of Mussoorie Forest Division (U.P.) at an elevation ranging about 2000 m to 2750 m above m s.l. The average rainfall of the area is 254 cm with maximum 75.21 cm (August) and minimum 0.41 cm (November). The mean maximum and minimum temperature for the hottest month are 30°C and 16°C and for the coldest month 9.4°C and 3.8°C respectively. The other site features, already described earlier by Singhal and Soni (1989) have been presented in brief in Table 1.

Experimental

Eight sites, representing the deodar (*Cedrus deodara*), chir (*Pinus roxburghii*) and oak (*Quercus leucotrichophora*) vegetational types were selected for the study. In each study site woody species were enumerated by the methods of Khan and Gupta (1960) and soil samples collected from the representative profiles. The collection of samples were done before the onset of monsoon. The soil samples so collected were analyesed as per the methods of Piper (1950) and Jackson (1967) for different characteristics. The

Table 1

General description of the sites

Forest Type	Locality	Altitude (m)	Slope		Soil depth	Predominant lithology
			Shape	Degree (%)		
Cedrus deodara	Dhanaulti 3 A	2310	Convex	45	Deep	Phylites, Shales and Sandstone
C. deodara	Dhanaulti 1 A	2375	Convex	30	Deep	Phylites, Shales and Sandstone
C. deodara	Dhanaulti 2 A	2325	Convex	45	Deep	Phylites, Shales and Sandstone
C. deodara	Dhanaulti 6 A	2300	Convex	25	Deep	Phylites, Shales and Sandstone
Quercus leucotrichophora	Dhanaulti 5 A	2000	Convex	40	Deep	Quartzites and Slates
Pinus roxburghii	Sorh 9 A	2225	Convex	30	Very Deep	Quartzites and Slates
Q. leucotrichophora	Than 3	2350	Convex	30	Deep	Quartzites and Slates
Q. floribunda	Dhanaulti 1 B	2350	Convex	50	Very Deep	Quartzites and Slates

Mean Annual Increment (M.A.I) of various species was calculated using field and volume tables available for this purpose.

Results and Discussion

It can be seen from Table 2 that the density of these forests varies between 1.9 to 6.4 trees 100 m^2, total basal cover varies between 160.87 to 9257.52 cm^{-2} 100^2 and mean basal cover between 280.31 to 3627.94 cm^2 tree^{-1} (Singhal and Soni, 1989).

As can be seen from Table 3, that the nutrient status in the litter varies from species to species depending upon their total dry weight contents and other characteristics. The litter under deodar is richer in Ca, Mg, N, P and K contents in comparison to chir and oak may be due to their older age as also reported by Kaul *et al.* (1979) for the sal forests of Dehra Dun area.

The values of productivity, expressed in terms of mean annual timber increment has also been found to depend largely on the status of total organic matter in soil and on those factors which influence the input of organic matter and rate of its decomposition

Table 2

Quantitative characters of tree species

Name of species	Frequency	Density Tree/100m^2	Abundance 100^{-2}m	Mean basal cover cm^2 Tree^{-1}	Total basal cover cm^2/100m^2
Site-1					
Cedrus deodara	100	3.30	2.30	763.69	1756.49
Deutzia staminea	20	0.30	1.50	480.64	144.19
Quercus floribunda	40	0.60	1.50	153.80	92.28
		4.20			1992.96
Site-2					
Cedrus deodara	100	6.40	6.40	1446.49	9257.52
Site-3					
Cedrus deodara	80	1.20	1.50	2791.64	3349.97
Quercus floribunda	40	0.50	1.25	229.91	114.95
Mechilus odoratissima	50	0.50	1.00	30.29	15.14
Rhododendron arboreum	30	0 30	1.00	576.10	172 83
		2.50			1652.65
Site-4					
Cedrus deodara	100	4.20	4.20	1243.00	5220.58
Site-5					
Pinus roxburghii	40	0.50	1.25	1860.77	930.39
Q. leucotrichophora	100	1.40	1.40	303.86	425.41
					1355.80
Site-6					
Pinus roxburghii	100	3.30	3.30	280.31	925.03
Site-7					
Q. leucotrichophora	90	1.20	1.30	77.35	92.83
Q. floribunda	30	0.30	1.00	121.69	36.51
Rhododendron arboreum	40	0 40	1 00	50.71	20.29
Lyonia ovalifolia	20	0.30	1.50	31 00	9.30
Cotoneaster bacillares	20	0 20	1 00	9.70	1.94
		2.40			160.87
Site-8					
Q. leucotrichophora	60	0.90	1.50	329.74	296.76
Q. floribunda	100	0.40	1.40	145.61	203.85
Rhododendron arboreum	70	0.90	1.29	101.50	91.35
Lyonia ovalifolia	30	0 40	1.38	70 10	28 04
Aesculus indica	20	0 20	1.00	112.37	22.47
		3.80			642.47

Table 3

Nutrient content in the litter samples under different forest covers and their relationship with the soil nutrient and M.A.I.

Vegetation	Ca (%)	Mg (%)	N (%)	P (%)	K (%)	C % of soil	pH	Moisture (%)	Mean annual increment (m^3/ha/yr)	Texture
Cedrus deodara	1.18	0.16	1.52	0.12	0.52	6.8	6.2	8.2	5.38	Silty
-do-	1.16	0.14	1.45	0.10	0.68	5.9	5.9	8.1	5.10	Silty loam
-do-	1.14	0.11	1.36	0.08	0.62	6.0	6.0	6.7	5.10	Silty clay loam
-do-	1.15	0.13	1.88	0.09	0.65	6.9	6.8	4.5	5.60	Silty
Pinus roxburghii	0.16	0.03	0.16	0.02	0.06	5.0	5.3	4.4	2.45	Silty loam
-do-	0.12	0.01	0.13	0.01	0.03	5.4	5.4	3.0	3.87	Silty loam
Quercus leucotrichophora	0.17	0.03	0.18	0.03	0.06	5.2	5.2	9.9	2.59	Silty
-do-	0.19	0.04	0.19	0.04	0.07	5.3	5.4	7.5	2.98	Silty clay loam

in soils. It is seen that the productivity of particular stand is related with its soil organic matter content. It increases with an increase in the content of soil organic matter as appeared in its correlationship with the deodar stands showing better productivity (r=0.59) as compared to chir (r=057) and oak (r=0.56). Productivity levels of these forest stands seem to be related with the relative degree of podzolisation of their soils as reported earlier by Singh and Singhal (1976) for similar soils.

It was interesting to see that the contents of micro-nutrients in the soil differ according to the type of vegetation under which these soils have developed and the mode of their accumulation. Their status is also dependent on the status of soil organic matter and the productivity of the forests. The soils under deodar have higher content of Mn, Zn, Cu, Fe as compared to chir and oak. Higher contents of these micro-nutrients in the illuviated horizons as compared to other horizons shows migration of micro-nutrients with the clay and humus. However, when the status of these micro-nutrients is examined, keeping in view the mean increment levels of the individual forest stands it is seen that the micro-nutrients such as Mn, Co and Cu have a greater relationship with the productivity than the other elements under study. In deodar stands where values of M.A.I. are higher as compared to chir and oak the contents of all the micro-nutrients are also high whereas other stands have ralatively less values. This is quite in agreement with the findings of Kaul *et al.* (1979).

Table 4

Study of the soils

Profile	Depth (cm)	Vegetation	Total Mn m.e. %	Total Zu m.e. %	Total Cu m.e. %	Total Fe m.e. %	Total Ca m.e. %	Total Mg m.e. %
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
I	0—18	*Cedrus deodara*	6.8876	0.3519	0.0942	8.2700	6.40	2.0079
	18—70		5.293	0.3672	0.0942	7.1600	9.20	1.1246
	70—120		4.4240	0.2601	0.0942	4.9225	2.80	1.3250
II	0—11	-do-	5.6827	0.2754	0.1099	4.8330	0.40	2.3200
	11—36		4.2635	0.3213	0.0942	7.7865	1.20	0.8497
	36 – 60		4.9090	0.0459	0.0471	2.2375	4.00	0.9163
	60—91		3.9930	0.2754	0.0942	6.1135	1.90	0.9163
	91—150		2.1054	0.2295	0.0942	2.2375	1.40	0.9330
III	0—14	-do-	8.8080	0.3519	0.1099	2.5955	3.60	1.6120
	14—50		8.7120	0.4131	0.1413	4.4750	4.40	0.7497
	50—90		7.2600	0.4590	0.1099	3.0430	3.60	1.2620
	90 —132		9.0750	0.5208	0.1413	6.2650	2.00	1.0579
	132—176		6.9790	0.5202	0.1413	6.9810	2.00	1.3078
IV	0—9	-do-	8.9860	0.3213	0.1099	8.5025	11.20	1.2580
	9—22		7.6160	0.2601	0.1570	7.7865	1.20	1.1745
	22—42		5.2460	0.2295	0.1413	3.1325	0.80	1.1745
	42—62		6.1500	0.3060	0.1570	6.2700	0.80	1.0550
	62—105		5.9790	0.2448	0.1413	6.5335	3.20	1.4450
	105—135		5.3724	0.1377	0.0471	4.6540	3.20	1.2650
V	0 –13	*Pinus roxburghii*	5.0820	0.2907	0.0942	7.0257	2.00	0.8747
	13—50		5.1183	0.0913	0.0471	6.4165	2.00	0.6851
	50—92		5.2635	0.4896	0.0942	7.1600	1.20	0.7747
	92—125		5.4450	0.3366	0.1099	4.1170	0.80	0.8497
	125 –160		5.8080	0.3213	0.0942	4.3855	0.80	0.8497

(*Contd ..*)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
VI	0—6	*Pinus roxburghii*	2.0328	0.1683	0.0942	4.5645	2.00	0.8663
	6—60		2.5410	0.2448	0.1099	7.3390	0.80	0.7914
	60 —103		2.7951	0.2295	0.1099	6.9810	0.40	0.7914
	103—147		2.3396	0.2448	0.1099	6.9810	0.40	0.8747
	147 —180		2.1747	0.3213	0.1413	5.5490	0.40	0.7664
VII	0—7	*Quercus leucotrichophora*	3.3396	0.2448	0.0942	7.7365	4.40	0.8663
	7—24		2.9403	0.2831	0.0942	6.2650	2.40	0.7914
	24—57		1.5246	0.2831	0.1099	3.1325	1.20	0.5408
	57—92		1.7424	0.3213	0.1099	3.5352	0.80	0.4498
	92—195		0.9438	0.1530	0.1099	4.4750	0.40	0.3415
VIII	0—17	-do-	4.1745	0.2601	0.1099	5.4595	3.20	0.7914
	17—57		4.1745	0.3060	0.1099	2.9535	1.60	0.6831
	57—92		4.2471	0.3519	0.0942	3.5800	1.60	0.8247
	92—185		4.0820	0.2907	0.1099	2.3270	2.40	0.9663

SUMMARY

Elemental composition of the litter under deodar, chir and oak forests of Mussoorie Himalayas were characterised with soil properties and mean annual increments of the species. The study revealed that the forests undrr deodar had higher M.A.I. associated with higher content of Mn, Zn, Mg, Cu and Fe in their soils in comparison to the forests under chir and oak.

गढ़वाल हिमालयी भाग के वनों की माध्य वार्षिक सवृद्धि का वहाँ की मृदा और भूमि पर पड़े पर्णास्तरण से सम्बन्ध

आर०एम० सिंघल व एस० सोनी

सारांश

मसूरी के हिमालयी भाग में हो रहे देवदार, बाँज और चीड़ के वनों की मूल तत्व रचना की विशिष्टताओं का संबन्ध वहां की मृदा विशेषताओं तथा उन वृक्ष जातियों की माध्य वार्षिक संवृद्धि के साथ जोड़ा गया है। अध्ययन से पता चला है कि देवदार वनों की माध्य वार्षिक संवृद्धि अधिक है जो चीड़ और बाँज के मुकाबले में उन वनों की मृदा में मैंगेनीज, जस्ता, मैगनीशियम, ताँबा और लोहा अधिक मात्रा में रहने से संबन्धित है।

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INFLUENCE OF DIFFERENT SOIL MIXTURES ON NURSERY GROWTH OF SOME ARID ZONE TREE SPECIES

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Introduction

Arid region is predominantly occupied by sandy soils which have very low water holding capacity and poor fertility. Such soil when used for raising nursery plants of the tree species of arid region, fails to support good seedling growth. Further, the sandy soil lacks aggregation because of which the container soil gets dispersed at the time of planting, leaving the seedling naked, planting of which results in poor survival. Therefore, to produce healthy seedling stock and to impart aggregation, use of suitable nursery soil mixture is of paramount importance. Pond sediment available from water tanks is often used for mixing with the nursery sand. Based on the preliminary studies conducted at Central Arid Zone Research Institute, Jodhpur, Mann and Muthana (1984) reported the suitability of mixture containing sand, FYM and tank silt in 1:1:1 ratio, for healthy seedling growth. However, systematic experiments need to be undertaken by taking FYM, tank silt and sand and also inorganic fertilizers in varying proportions and their combinations to indentify the most suitable mixture for healthy growth of the seedlings of different species. This may vary from species to species as well. Delwaulle (1977) found the mixture, compost : sand : soil in ratio of 1 : 1 : 2, the best for raising nursery stock of *Eucalyptus camaldulensis* in Nigeria. For the nursery plants of broadleaved species in Fiji, a soil mixture of forest soil : sand in ratio of 4 : 1 was found most ideal (Evans, 1983).

Experimental results pertaining to Acacias in arid zone have been reported by Gupta *et al.* (1991). The present study was undertaken to findout the influence of varying rates of pond sediment, FYM and fertilizer mixing on seedling growth of *Prosopis cineraria* and *Albizia lebbek*, both planted under rained conditions, and *Dalbergia sissoo* which is an important species of IGNP command area in Western Rajasthan.

Materials and Methods

The study was conducted at the Arid Forest Research Institute, Jodhpur in the year 1989. The treatments, in factorial combinations, were comprised of mixing with sand the different rates of pond sediment (tank silt), Farm Yard Manure (FYM), nitrogen and phosphorus Relevant properties of sand, tank silt and FYM are given in Table 1. The treatments were comprised of mixing 0, 10, 15 and 20 per cent tank silt; 0. 2, 4 and 6 per cent FYM and 0, 20 and 40 ppm N (as urea), making 48 mixtures in factorial combinations. Another set of 48 mixtures was comprised of three rates of P_2O_5, 0, 15 and 30 ppm (in the form of single superphosphate) and four levels of each of tank silt and FYM as above. Sand, tank silt and FYM were weighed and mixed in different proportions to prepare different mixtures. Urea and single superphosphate were dissolved in water in specified quantity and mixed to get different mixtures. The mixtures were thoroughly mixed and filled in polythene bags of size 27×11 cm. Each treatment (mixture) had 30 bags in three replications in completely randomised design. Afer watering, seeds of *Dalbergia sissoo*, *Prosopis cineraria* and *Albizia lebbek* were sown on 18-4-1989. Only one seedling per bag was retained after germination. The nursery was watered everyday during the experimental period. The data on seedling height recorded after 120 days are presented and discussed in the subsequent section.

Table 1

Properties of the tank silt and sand used in the nursery

	Tank silt	Sand
pH	7.90	8 87
EC_2 (dSm^{-1})	2.11	0.23
Available N ($kg\ ha^{-1}$)	310	87
Available P_2O_5 ($kg\ ha^{-1}$)	75.2	4.5
Clay (%)	12	7
Silt (%)	45	4
Sand (%)	43	89

The FYM used contains 1.60 per cent nitrogen and 0.27 per cent phosphorus.

Results and Discussion

Effect of Tank Silt : Influence of mixing tank silt was significant on the seedling height of all the three species. The average effects (presented in Table 2 to 4) indicate that mixing 10 per cent tank silt increased the height of *Dalbergia sissoo* by 20 per cent (higher proportion of tank silt was not further beneficial). On average, 15 per cent tank silt increased the height of *Albizia lebbek* by 25 per cent; increased the height of *Prosopis cineraria* only marginally. Data on the influence of mixing tank silt alone are given in Table 5. Mixing of 10 per cent tank silt alone increased the seedling height of *Prosopis cineraria* from 30 to 41 cm. Higher proportion of clay soil was not beneficial for the former two species but the seedling height of *Dalbergia sissoo* increased to 53 cm (a net increase of 90 per cent) when rate of tank silt mixing was enhanced to 15 per cent.

Effect of FYM : Average effect of mixing Farm Yard Manure (FYM) was significant on seedling growth of *Prosopis cineraria* and *Albizia lebbek* but not on *Dalbergia sissoo* (Tables 2 to 4). On average, mixing 4 percent FYM increased the seedling height of *Albizia lebbek* by 25% and of *Prosopis cineraria* by 15 per cent. Interestingly, when only FYM was mixed, significant plant response was observed at 2% FYM. The higher rate of FYM mixing did not cause further growth of seedlings (Table 5). With the mixing of 2% FYM alone, seedling height increased from 30 to 45 cm in *Prosopis cineraria*, 20 to 30 cm in *Albizia lebbek* and 28 to 38 cm in *Dalbergia sissoo*.

Table 2

Interaction effect of tank silt, FYM, nitrogen and phosphorus on seedling height (cm) of Dalbergia sissoo

	C_0	C_{10}	C_{15}	C_{20}	Mean	C.D. (5%)
N_0	33	46	47	48	44	Silt : 3.0
N_{20}	40	48	47	48	46	N : NS
N_{40}	43	48	45	48	46	Silt × N : NS
Mean	39	47	46	48		
	M_0	M_2	M_4	M_6	Mean	
N_0	42	43	46	46	44	FYM : NS
N_{20}	44	47	45	47	46	FYM : N : NS
N_{40}	46	43	49	47	46	
Mean	44	44	47	46		
	M_0	M_2	M_4	M_6	Mean	
C_0	37	39	43	40	40	FYM × Silt : 6.6
C_{10}	45	50	48	48	48	
C_{15}	48	41	48	48	46	
C_{20}	46	46	51	49	48	
Mean	44	44	47	46		
	C_0	C_{10}	C_{15}	C_{20}	Mean	
P_0	42	45	47	48	45	
P_{15}	44	46	42	51	46	P : NS
P_{30}	41	46	45	45	44	P × Silt : NS
Mean	42	45	45	48		
	M_0	M_2	M_4	M_6	Mean	
P_0	44	45	44	48	45	FYM × P : 5.7
P_{15}	46	48	45	45	46	
P_{30}	45	46	47	39	44	
Mean	45	46	46	44	—	

C_0, C_{10}, C_{15}, C_{20} : 0, 10, 15 & 20% tank silt
N_0, N_{20}, N_{40} : 0, 20 and 40 ppm Nitrogen
M_0, M_2, M_4, M_6 : 0, 2, 4 & 6% FYM
P_0, P_{15}, P_{30} : 0, 15 and 30% Phosphorus
NS : Not Significant
CD : Critical Difference

Table 3

Interaction effect of tank silt, FYM, nitrogen and phosphorus on seedling height (cm) of Albizia lebbek

	C_0	C_{10}	C_{15}	C_{20}	Mean	C.D. 5%
N_0	28	31	35	36	32	Silt : 2.9
N_{20}	33	32	39	37	34	N : 2.5
N_{40}	33	38	37	39	37	Silt × N : NS
Mean	30	34	37	37		
	M_0	M_2	M_4	M_6	Mean	
N_0	28	33	36	32	32	FYM : 2.9
N_{20}	30	33	35	39	34	FYM × N : NS
N_{40}	33	37	40	36	36	
Mean	30	34	37	36		
	M_0	M_2	M_4	M_6	Mean	
C_0	24	31	33	32	30	FYM
C_{10}	30	34	35	35	34	Silt × : NS
C_{15}	32	34	40	42	37	
C_{20}	35	38	42	34	37	
Mean	30	34	38	36	—	
	C_0	C_{10}	C_{15}	C_{20}	Mean	
P_0	30	34	35	33	33	P : NS
P_{15}	31	35	34	36	34	Silt × P : NS
P_{30}	33	36	31	33	34	
Mean	32	35	33	34		
	M_0	M_2	M_4	M_6	Mean	
P_0	30	32	35	35	33	FYM × P : 4.2
P_{15}	32	34	35	33	34	
P_{30}	31	36	37	31	34	
Mean	31	34	36	33		

C_0, C_{10}, C_{15}, C_{20} : 0, 10, 15 and 20% tank silt

N_0, N_{20}, N_{40} : 0, 20 and 40 ppm Nitrogen

M_0, M_2, M_4, M_6 : 0, 2, 4 and 6% FYM

P_0, P_{15}, P_{30} : 0, 15 and 30% Phosphorus

NS : Not Significant

CD : Critical Difference

Table 4

Interaction of tank silt, FYM, nitrogen and phosphorus on seedling height (cm) of Prosopis cineraria

	C_0	C_{10}	C_{15}	C_{20}	Mean	C D. (5%)
N_0	36	39	32	37	36	Silt 1.8
N_{20}	37	36	36	38	37	N : NS
N_{40}	38	37	33	42	38	Silt × N 3.1
Mean	37	38	34	39		
	M_0	M_2	M_4	M_6	Mean	
N_9	35	38	39	32	36	FYM : 1 8
N_{20}	37	38	39	36	37	FYM × N : 3.1
N_{40}	34	36	41	40	38	
Mean	35	37	40	36		
	M_0	M_2	M_4	M_6	Mean	
C_0	31	43	42	32	37	Silt × FYM : 3.6
C_{10}	38	37	40	36	38	
C_{15}	35	32	34	35	34	
C_{20}	37	37	43	41	39	
Mean	35	37	40	36	37	
	C_0	C_{10}	C_{15}	C_{20}	Mean	
P_0	38	36	37	39	37	P NS
P_{15}	35	39	32	39	36	Silt × P : 3.1
P_{30}	39	39	33	38	37	
Mean	37	38	33	39	37	
	M_0	M_2	M_4	M_6	Mean	
P_0	35	36	37	39	37	FYM × P : 3 1
P_{15}	34	37	38	36	36	
P_{30}	36	40	39	35	37	
Mean	35	38	38	36		

C_0, C_{10}, C_{15}, C_{20} : 0, 10, 15 and 20% tank silt
N_0, N_{20}, N_{40} : 0, 20 and 40 ppm Nitrogen
M_0, M_2, M_4, M_6 : 0, 2, 4 and 6% FYM
P_0, P_{15}, P_{30} : 0, 15 and 30% Phosphorus
NS : Not Significant
CD : Critical Difference

Table 5

Growth of nursery seedlings as affected by mixing different rates of nitrogen, tank silt and FYM

Tank Silt (%)	FYM (%)	*Prosopis cineraria*			*Albizia lebbek*			*Dalbergia sissoo*		
		Nitrogen levels (ppm)								
		0	20	40	0	20	40	0	20	40
0	0	30	32	30	20	24	28	28	37	46
	2	45	44	41	30	30	33	38	45	34
	4	44	43	37	32	34	33	37	43	49
	6	25	28	42	28	32	36	38	37	44
10	0	41	39	35	29	27	34	41	45	49
	2	37	40	34	31	29	42	50	51	49
	4	46	33	40	29	32	44	45	45	48
	6	34	34	41	35	38	33	49	51	46
15	0	36	36	33	31	33	31	53	49	42
	2	36	32	28	33	34	35	39	43	41
	4	28	35	39	36	36	50	45	44	52
	6	30	41	33	38	53	34	49	51	44
20	0	35	34	36	33	35	37	45	46	47
	2	33	37	42	36	39	39	44	49	45
	4	38	43	47	47	39	40	55	50	48
	6	40	40	43	29	33	41	47	48	52
C.D. 5% (N × FYM × Silt)			N S			10.1			6.2	

Effect of Nitrogen : Average effect of nitrogen addition was significant on seedling growth of *Albizia lebbek* and not on the growth of other two species (Tables 2 to 4) When 40 ppm nitrogen alone was added (data in Table 5), the seedling height increased from 20 to 28 cm in *Albizia lebbek* and 28 to 46 cm in *Dalbergia sissoo*. However, *Prosopis cineraria* did not respond to application of nitrogen alone.

Effect of Phosphorus : None of the species in the nursery experiment responded to the application of phosphorus (Tables 2 to 4 and 6).

Interaction Effects : The mean effects of combined applications of tank silt and FYM, tank silt and nitrogen, tank silt and phosphorus and FYM and phosphorus, on seedling growth of different tree species are given in Tables 2 to 4. In *Dalbergia sissoo*,

Table 6

Growth of nursery seedlings as affected by mixing different rates of phosphorus, tank silt and FYM

Tank Silt (%)	FYM (%)	*Prosopis cineraria*			*Albizia lebbek*			*Dalbergia sissoo*		
		Phosphorus levels (ppm)								
		0	20	40	0	20	40	0	20	40
0	0	34	33	36	26	29	31	40	45	38
	2	39	41	41	33	34	39	40	46	42
	4	35	31	40	32	31	32	39	40	39
	6	42	35	40	31	31	31	47	46	43
10	0	37	39	40	32	28	31	50	44	45
	2	34	39	42	32	36	36	44	50	52
	4	38	44	37	35	40	40	46	49	48
	6	35	34	35	36	34	36	38	41	38
15	0	32	27	31	29	30	26	42	38	51
	2	34	32	32	31	33	34	41	47	43
	4	40	36	34	39	35	38	46	39	47
	6	34	33	35	42	37	38	60	43	41
20	0	38	38	37	33	41	37	44	56	47
	2	38	37	44	33	34	37	54	50	48
	4	36	41	43	32	36	40	45	50	54
	6	45	41	29	32	31	19	48	48	32
C.D. 5% (Silt × FYM × P)		6.2			10.1			NS		

mixing of tank silt alone played a paramount role and the 10 per cent of it improved the seedling growth from 33 to 46 cm (Table 2). Coupling 2 per cent FYM with 10 per cent tank silt further increased the growth significantly. Thus mixing 10 per cent tank silt + 2 per cent FYM with sand formed the best mixture for nursery seedlings of *Dalbergia sissoo*.

In *Albizia lebbek* combined application of FYM, tank silt and nitrogen significantly influenced the seedling growth (Table 5). Mixing 10 per cent tank silt + 4 per cent FYM + 40 ppm N increased the seedling growth from 20 to 44 cm. Mohan *et al.* (1990) also reported significant response of *A. lebbek* to finer texture and nitrogen application. Equally effective was the treatment 20 per cent tank silt + 4 per cent FYM.

Seedling growth of *Prosopis cineraria* was significantly influenced by various combinations of tank silt, FYM, nitrogen and phosphorus. However, mixing of only 2% FYM increased the seedling height by 50 per cent (Table 5). Mixing of 10 per cent tank silt was also effective which may be preferred for its additional advantage of promoting aggregation and keeping the potting mixture intact with seedlings.

It is concluded from the study that to produce healthy nursery seedlings for tree planting in arid zones, 10 per cent tank silt + 2 per cent FYM should be mixed with sand for *Dalbergia sissoo*, 10 per cent tank silt + 4 per cent FYM and 40 ppm nitrogen for *Albizia lebbek* and only 10 per cent tank silt for *Prosopis cineraria*.

SUMMARY

Arid regions of Rajasthan are predominantly occupied by sandy soil. The nursery stock raised on such soil is poor and often results in heavy mortality when out planted. Therefore, a nursery experiment was conducted by mixing different levels of tank silt (0, 5, 10 and 20%), farm yard manure (0, 2, 4 and 6%), nitrogen (0, 10, 20 and 40 ppm as urea) and phosphorus (0, 15 and 30 ppm P O, as single superphosphate) to findout the suitable mixture for producing healthy seedlings of some arid zone tree species. The study indicated significant influence of mixing tank silt and FYM, with sand, on the seedling growth of *Dalbergia sissoo*, *Albizia lebbek* **and** *Prosopis cineraria*. **Response to nitrogen application was shown only by** *Albizia lebbek*. **None of the species responded to phosphate application. The potting mixture producing the best healthy seedlings in this study were, 10 per cent tank silt + 2 per cent FYM for** *Dalbergia sissoo*, **10 per cent tank silt + 4 per cent FYM + 40 ppm nitrogen for** *Albizia lebbek* **and 10 per cent tank silt for** *Prosopis cineraria* **Use of tank silt improved the aggregation and the mixture remained intact with the seedling when polythene bag was removed.**

विभिन्न मृदा मिश्रणों का कतिपय शुष्क प्रदेश की वृक्ष जातियों की रोपणी में होती वृद्धि पर प्रभाव

जी०एन० गुप्त

साराँश

राजस्थान के शुष्क क्षेत्रों में प्रधानत: रेतीली मृदा पाई जाती है ! ऐसी मृदाओं में उगाए गए रोपणी के पौधे कम जान होते हैं और क्षेत्र में रोपे जाने पर बड़ी सख्या में मर जाते हैं। अत: एक रोपणी परीक्षण विभिन्न स्तरों में तालाब की साद (0, 5, 10 और 20%), गोबर की खाद (0, 2, 4 और 6%) नाइट्रोजन (0, 10, 20 और 40 भाग प्रति दस लाख भाग में मिले, यूरिया के रूप में) और फास्फोरस (0, 15 और 30 भाग प्रनि दस लाख भाग में मिलाकर, पी$_2$ ओ$_5$ अकेला सुपरफास्फेट) मिलाकर कतिपय शुष्क क्षेत्र वृक्ष जातियों के स्वस्थ पौधे उगाने के लिए उपयुक्त मिश्रण मालूम करने के लिए किया गया। अध्ययन से *डलबर्गिया सिस्सू*, *एल्बिजिया लेब्बेक* और

प्रोसोपिस सिनेरेरिया के पौधों की वृद्धि पर रेत में तालाब की साद और गोबर की सड़ाई खाद मिलाने पर सार्थक प्रभाव होने का संकेत मिलता है। नाइट्रोजन देने का प्रतिचार केवल एल्बिजिया लेब्बेक में हुआ। किसी भी वृक्ष जाति में फास्फेट देने का प्रतिचार नहीं हुआ। गमलो के जिन मिश्रणों से इस अध्ययन में सबसे स्वस्थ पौधे बने वे 10% तालाब की साद +4% गोबर की सड़ाई खाद +40 भाग प्रति दस लाख भाग में मिली नाइट्रोजन एल्बिजिया लेब्बेक के लिए, 10% तालाब की साद प्रोसोपिस सिनेरेरिया के लिए रहे। तालाब की साद उपयोग करने पर मिट्टी जमना सुधरा और पोलिथीन की थैली हटा देने पर भी मिश्रण यथापूर्व बना रहा।

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RESEARCH NOTES

(I)

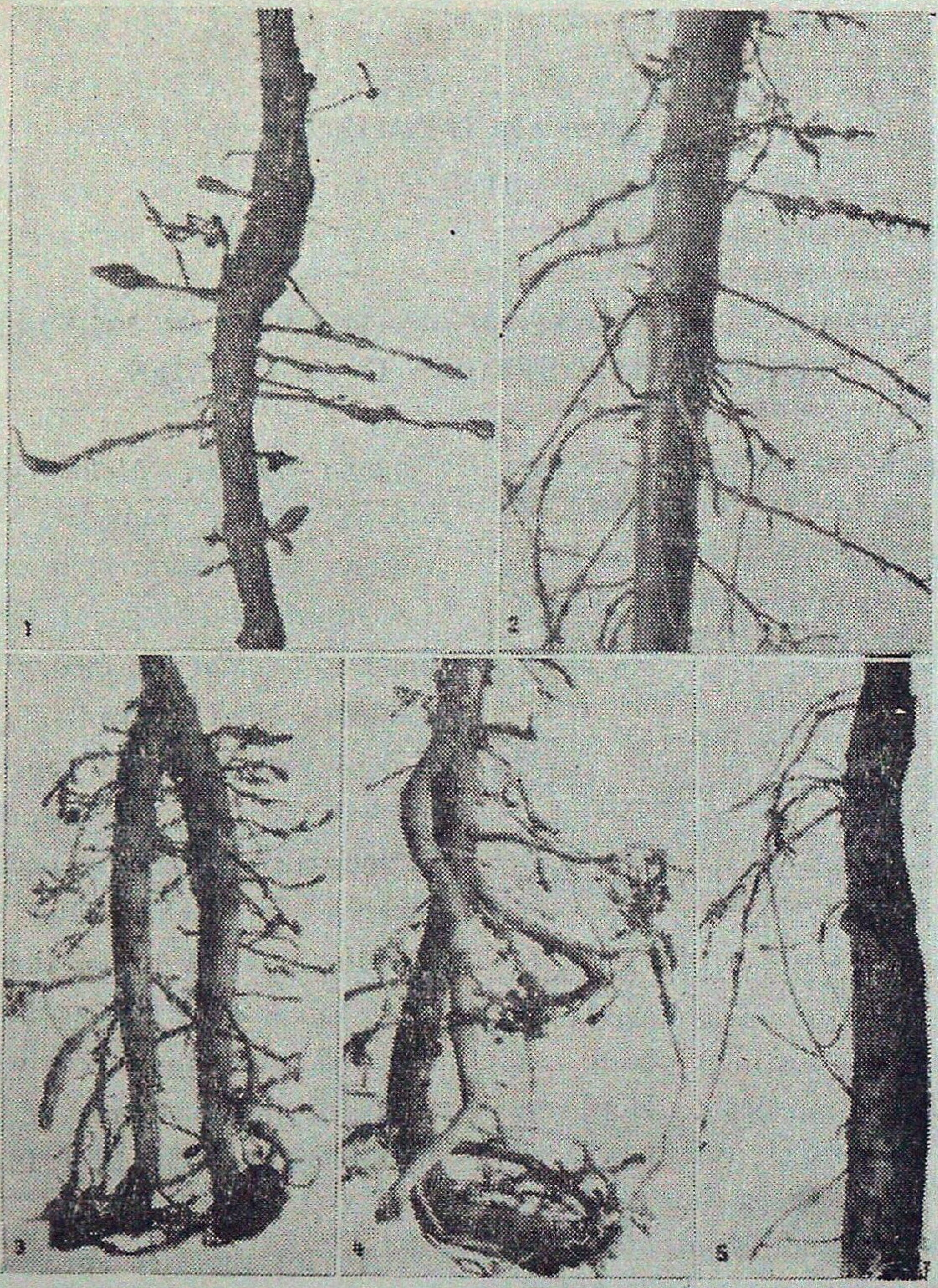
MELOIDOGYNE SPP.—CAUSE OF ROOT-KNOT OF IMPORTANT FOREST TREE SPECIES IN NURSERIES

During forest disease surveys conducted in nurseries in and around Dehra Dun in 1990-91 the authors recorded root-knot nematodes parasitizing important tree species namely *Acacia catechu* Willd , *Albizia procera* Benth., *Pongamia pinnata* Pierre and *Tectona grandis* Linn. The infected plants exhibited galling and relatively poor growth. Three species of *Meloidogyne* were identified as *M. arenaria* (Neal) Chitwood, *M. javanica* (Treub) Chitwood and *M. incognita* (Kofoid and White) Chitwood based on their perineal pattern. *Meloidogyne javanica* attacked root of *Pongamia pinnata* seedlings both at Lacchiwala and Kalsi nurseries. However, the incidence of root infestation at Lacchiwala was more (40%) than at Kalsi (10%). On the other hand, *M. javanica* was recorded on *Albizia procera* at Kalsi and it was absent at Lacchiwala. The infection in this tree species varied from 15-20%. The incidence of *M. javanica* infestation in *Acacia catechu* varied from 10-30% in nurseries at Lacchiwala, Kalsi and Karuapani.

It was of interest to note that three species of *Meloidogyne* were associated with *Tectona grandis*. *Meloidogyne javanica* was recorded from nurseries at Karuapani whereas *M. arenaria* occurred in nurseries at Lacchiwala and Satyanarayan. On the other hand, *Meloidogyne incognita* occurred in nurseries at Lacchiwala, New Forest and Kalsi. Out of three root-knot nematode species recorded, *M. javanica* appeared to be the most commonly occurring in forest nurseries in Dehra Dun and *Pongamia pinnata* appeard to be the most preferred host for this species as both number and size of galls produced were more than recorded in other tree species parasitized by the nematode (Plate 1, Figs. 1-5).

In all the tree species fresh infection started after a few monsoon showers in July and by October end seedlings showed maximum infection as was evident from galling in roots. However, the infection started declining and the number of galls was greatly reduced during summer. All the three species are new host records for *M. javanica* whereas *T. grandis* is recorded for the first time parasitized by *M. arenaria.*

Plate 1



Figs. 1-5. Nematode galls. 1. Galls incited by *Meloidogyne arenaria* on *Tectona grandis*. Galls incited by *Meloidogyne javanica* on 2. *Pongamia pinnata*, 3. *Tectona grandis*, 4. *Albizia procera*, 5. *Acacia catechu*.

Acknowledgement

The financial support by the Department of Science & Technology is gratefully acknowledged by one of the authors (VS).

Forest Pathology Division,
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V. Sharma*
and
M.D. Mehrotra**

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** Head, Forest Pathology Division.

(II)

DIURNAL VARIATION IN WATER STATUS OF *EUCALYPTUS* AND POPLAR LEAVES IN A WARM SUNNY DAY

Importance of water status of plants have been recognised for centuries but until recently it could be described only in such general terms of wilted or unwilted. In the first third of this century plant water status was measured more frequently in terms of Osmotic pressure or Osmotic potentials of expressed sap. However, validity of measurements on expressed sap was questioned and use of this method was discouraged, it became apparant by 1930's that water movement is plants was controlled by what is now termed as water potential. Water potential is defined as the difference in free energy or chemical potential between pure water and water within the system under study. The potential of pure water is zero. Therefore, leaf or soil water potential is less than zero (negative) and is indicated by more negative values in bar units. In present study an attempt was made to find out relationship of leaf water potential with other measures of water content such as Relative Water Content (RWC) in young and old *Eucalyptus* and Poplar leaves.

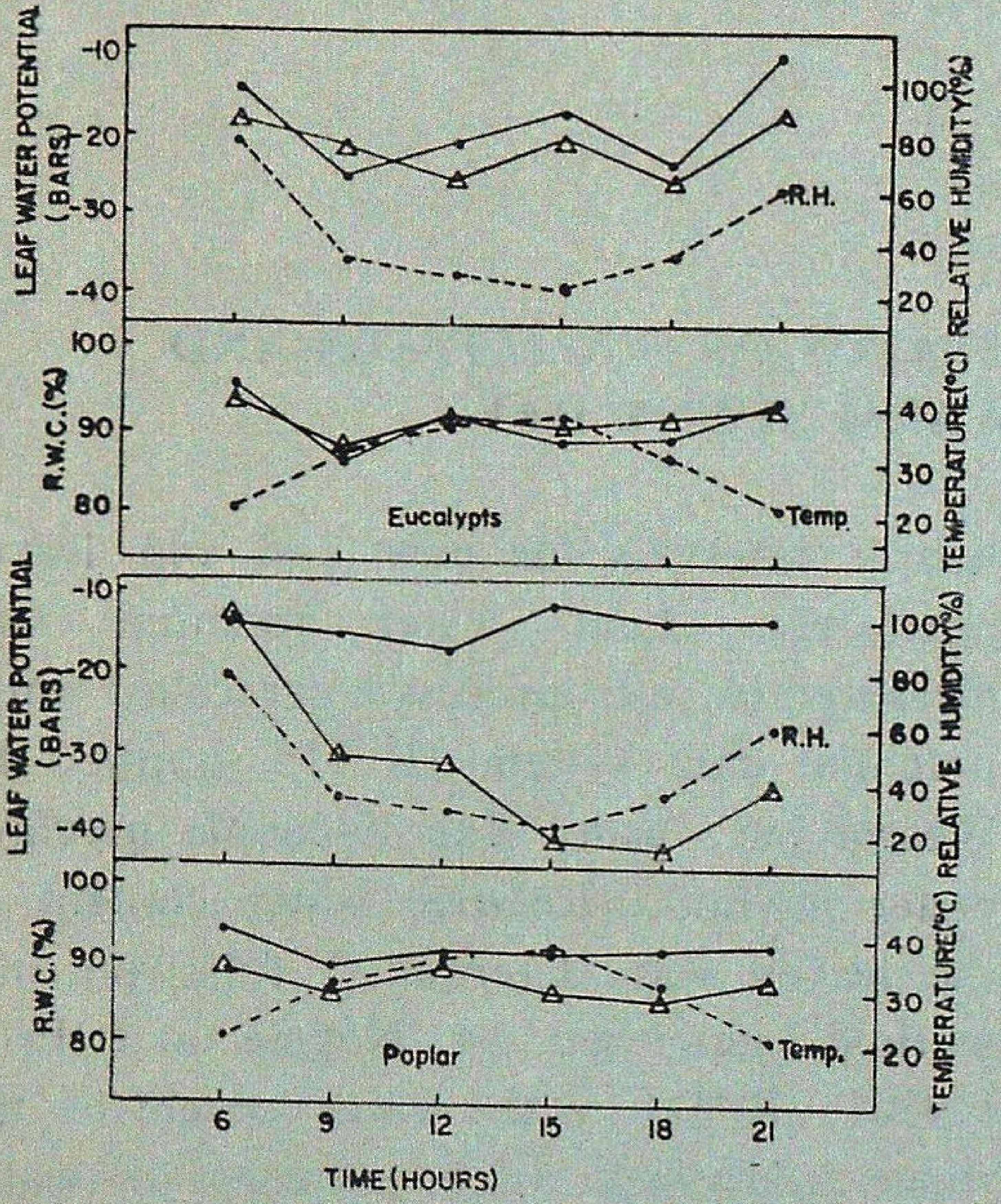
Diurnal variation in leaf water potential and Relative Water Content (RWC) in the leaves of a three year old, adjoining *Eucalyptus* hybrid and Poplar plantations at F.R.I. demonstration area were measured on a warm sunny day of May 1988 at three hourly intervals for new and old leaves separately. Leaf water potential was measured by microprocessor cantrolled water potential data system HP 115 supplied by Wescor Inc., using Thermocouple psychrometer method. Relative water content of the leaves was determined following the method described by Noggle and Fritz (1976). R W.C. is the water content of the tissue expressed as a per cent of water content of the fully turgid tissue and is determined by following formula.

$$\text{R.W.C. } (\%) = \frac{\text{Wf} - \text{Wd}}{\text{Wf} - \text{Wd}} \times 100$$

Where Wf=Fresh leaf weight, Wt=turgid weight, Wd=dry weight.

Diurnal pattern of leaf water potential were similar for leaves of both the species although amplitude of change differed (Fig. 1). At the time of sunrise leaf water potential in the young leaves of *Eucalyptus* was more negative than old leaves, while it remained almost same for poplar leaves. With increase in day temperature and radiation leaf water potential was more and more negative and tend to regain its original status two or three hours after sunset. Young leaves of both the species responded quickly for change in ambient environment. There was a very sharp decrease in leaf

Fig. 1



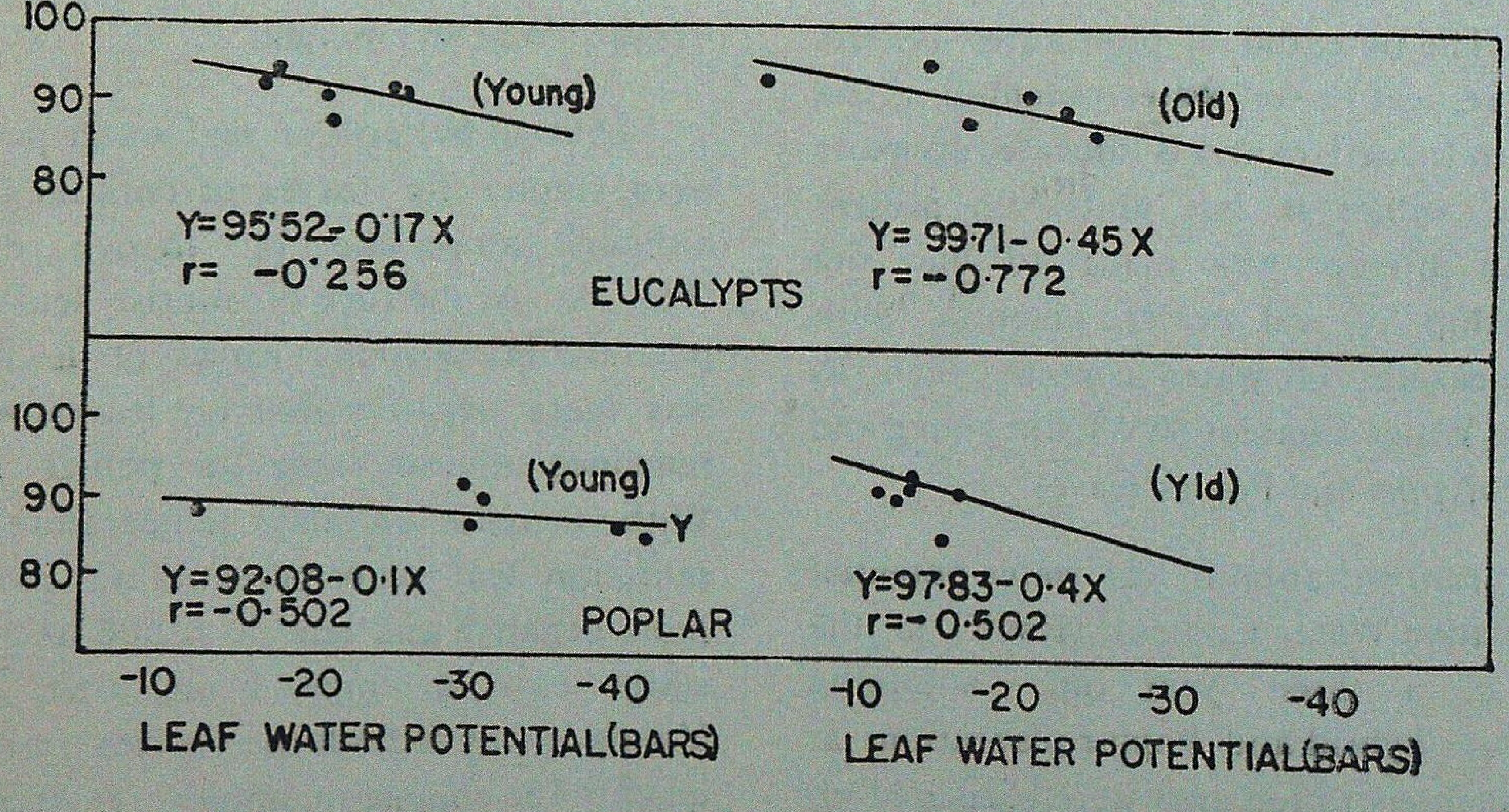
Diurnal variation in Relative Water Content (R.W.C.) and Leaf Water Potential (Ψ) of young (△—△) and old (●—●) leaves of eucalypts and poplar.

water potential (greater negativity) of young poplar leaves and they could not regain their original levels of water potential even after 3 hours of sunset. The diurnal trend in water potential of young and old leaves of poplar was markedly different while low differences were observed in eucalypts leaves.

The relative water content was higher at time of sunrise which gradually decreases with increase in hours of day time and finally regain its original status after 2-3 hours of sunset.

Measurements of relative water content may be used to estimate leaf water potential by establishing the correlation curves. The relationship between RWC and leaf water potential is not linear. Slatyer (1967) showed that when ever RWC drops from 100% to 60-50%, there is an initial sharp decrease (greater negativity) in leaf water potential.

Fig. 2



Relationship between Leaf Water Potential and R.W.C. (%)

In the present investigation the relationship changes with age of leaves and species to sepcies (Fig. 2). Slatyer (1967), Kripling (1967), Zur *et al.* (1981) have also reported the differing relationship of leaf water potential and RWC. These differences in RWC and leaf water potential also might provoke some thought concerning the complex nature of cell water relationship and difficulty of evaluating plant water status and drought tolerance from any one type of measurement.

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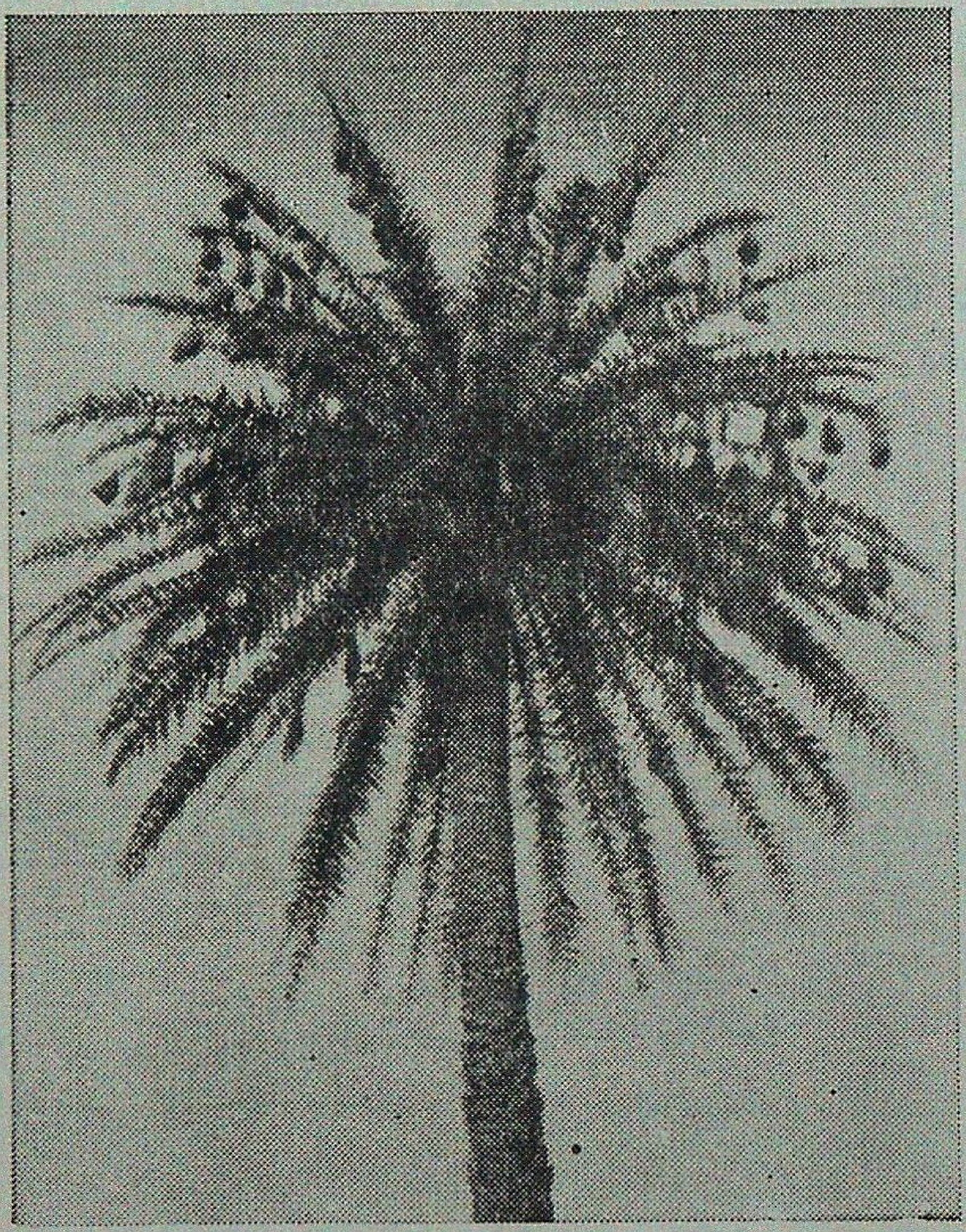
and
S.C. Sharma

FOREST NOTES AND OBSERVATIONS

NESTS OF BAYA

I came across a unique specimen of 76 nests of Baya (*Ploceus philippinus*) on a *Phoenix* spp., in Alwar near Stadium.

In Rajasthan, the nests of Baya are usually found on *Acacia* spp.



P.S. Bhatnager
Dy. Conservator of Forests,
Jaipur (Rajasthan)

From the Indian Forester—One Hundred Years Ago

THE INDIAN FORESTER

October, 1892 (pp. 382-383)

FOREST AND REVENUE OFFICERS

One of the matters which most urgently calls for reform in our Forest policy is that of making the Forest Settlement really legal and done in a similar legal manner and with the same formalities in all Provinces. What do we find, however ? No less an authority than Mr Baden-Powell who has been the acknowledged referee on all legal Forest questions for many years and who helped to pass the Indian Forest Act of 1878 and some of its successors, has recently told us in these pages that many of the so-called Settlements done in India are quite illegal; that the formalities prescribed by the Act have, in many Provinces, been totally disregarded; that rights have been constituted where there was absolutely no reason to load the State property with such serious burdens; and that, in short, the whole intention of the Act and its framers has been, purposely or not, evaded. We feel sure that in the North-West Provinces and probably also in the Punjab, most of the so-called Forest Settlement Work would not stand for a moment in a properly tried case before a High Court and we may doubt whether, in some other Provinces, it is much better, in spite of the oft-repeated warnings issued by the Government of India and the Inspector-General of Forests. In Bombay and Burma, we believe that the authorities have fully recognized the necessity of strict attention to procedure and strict accuracy in record and description, and we know that such is the case in Madras. It ought to have been the case everywhere.

Take again the case of Working Plans. How is it that many of our Working Plans are simple and easy and to the point and can not but commend themselves to anybody, be he Forester or not, as valuable and important bases for forest management; but others have almost failed already, or if they have not failed, have had to be so modified in practice as to differ already considerably from their original form ! Surely in this we want some further development, as it seems quite impossible that the Inspector-General, assisted only by a comparatively junior officer, who has a considerable amount of other work to attend to, should be able to cope with the important question.

Then, too, the systematizing of records, the collection of sylvicultural information and the regulation of experimental works all require some further development at Imperial Head-quarters. In our opinion, an opinion which we have held for long, the professional side of the Department should be controlled by a Board, as it is in France and Germany, consisting of an Inspector-General and at least two Deputy Inspectors-General. One of these should have sole control of Settlement, and the other of Working Plans operations, while in other general matters and on the line of action to be taken in these, they should be deliberate as a Board. Then too, the Provincial work should be more systematic—the interference of Boards of Revenue and Financial Commissioners in all internal questions should be abolished; and the Conservator, if there is only one, should hold to the Local Government the position that the Inspector-General holds to the Government of India. If there are more than one, they should form a Board of advisers under the local Revenue Secretary. Divisional Officers should, whenever possible, be, as in Madras, Assistants to the Collectors; and in those places where this is not feasible as it possibly may not be in some localities, they should be under the Conservators, but obliged to consult the Collectors on every important question which concerns them in the least.

The Imperial consulting Board would travel all over India, not together, but to those places where the special subjects of each were most important : and their reports on professional subjects should be passed by the Government of India, and sent to Local Government to be carried out; while those on other subjects should be submitted to the Local Governments for such action as they might think necessary, the understanding being that the recommendations should be carried out, unless sufficient reasons existed against them.

In the same way, the Conservators would control the local works in a lesser degree, reporting to their Governments, who would issue their orders to the Collectors concerned. Below the grade of Collector, no Revenue or other official should be allowed to interfere, but the District Forest Officer should, under the Collector's orders and supervision, carry out the Conservator's instructions and supervise the forests and their staff and finance.

LETTER TO THE EDITOR

To,

The Hony, Editor,
Indian Forester,
P.O. New Forest,
Dehra Dun (U.P.)

Sub : *Revising the term 'Minor Forest Produce'*

Sir,

The term Minor Forest Produce (MFP) has no doubt lost its significance in today's context, since the revenue and services being generated by this sector of Forestry is much more than the so-called Major Forest Produce i e. timber etc. There is, therefore, a strong need to re-think in terms of revising the terminology from '*Minor*' to some more *appropriate* term that could more clearly bring out and highlight the latitude and the mangitude of this sector of Forestry.

Several alternate terminologies such as *Non-Timber Forest Products* and *Multi-Use Forest Produce* have been proposed by various people. It has been recently suggested to change the terminology, to '*Forest Produce*', for the produce from forest while the forest is intact, and '*Forestry Produce*', for the produce from forest as a result of some intervention, to replace the earlier terminology of 'Minor Forest Produce' and 'Major Forest Produce' i e. timber etc. respectively.

The literal meaning of 'Forest' is a piece of land covered by the tree population and 'Forestry' could be defined as an activity(s) related to the forest. If the above suggested terms are considered from this angle, there appears to be no difference between the two, in differentiating the above mentioned forest produce(s) (obtained from forest). It does not seem to us to carry the meaning clearly indicating the type of produce, whereas the term 'Non-Wood Forest Produce' gives a clear cut idea of the type and origin of the 'produce' from the forest.

Hence, it will be more appropriate and justified to accept the term *'Non-Wood Forest Produce'* (NWFP) to replace the earlier 'Minor Forest Produce' terminology.

I would, therefore, take this opportunity to invite valuable comments/suggestions from the Foresters, Scientists and others interested in the area of Forestry, research, teaching and extension etc. on the above proposed term of *Non-Wood Forest Produce* (NWFP) as a replacement of the existing term *Minor Forest Produce* (MFP) to help us evolve a consensus on the terminology to facilitate smooth exchange in the various scientific, technological and trade developments.

Yours sincerely,
Sd./– C.L. Goel,
Head
Non-Wood Forest Products Division,
Forest Research Institute (ICFRE),
P.O. New Forest, Dehra Dun (U.P.)

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OBITUARIES

(I)

M.N. Asthana

(1923-1992)

Mahendra Nath Asthana joined the Indian Forest College in April 1948 and entered the U.P. Forest Department in 1950. He took his M.Sc. and LLB degrees from Allahabad University. Before entering the Forest College he had competed for the entrance to the prestigious Thomson College of Civil Engineering which he left after a short period. After serving the Forest Department for twelve years he joined the Logging Branch of the FRI in 1962 and remained there till 1968. He left the FRI to join a one year course in M.Sc. Forestry at the New Brunswick University in Canada. After coming back he rejoined the Forest Department in 1969 and worked in various capacities till 1975. He took voluntary retirement from the IFS in that year and went to Malaysia to take up teaching assignment at the forestry faculty in the University Pertanian. He remained in Malaysia till 1979. Coming back to India he joined the Agricultural University, Ludhiana where he remained till Dec. 1982. He finally settled down to retired life, first in his ancestral home in Allahabad and later shifted to Durgapur to live with his elder son.

Asthana was known for his quiet, unhurried and dignified ways which earned him the nickname of "Navab" at the Forest College. I still remember him vividly as he stood on the Nainital-Bhowali road at the start of the long and grinding physical test (qualifying test for entrance to Forest College) with a staff in hand and pockets full of dry fruit. At the word go, some of us made a dash as if it was an Olympic race. Asthana repeatedly told us not to run and take it easy. All we had to do was to complete the route in 5 hours and that there were no prizes awaiting us at the finish. No one heeded his advice and the result was that while we reached the final check point in about 3½ hours frothing and panting and coughing with blisters on the feet, our "Navab" made it leisurely in just under 5 hours munching on his ample supply of dry fruits. He showed this maturity throughout his brief years in the Forest Department. One never heard him raise his voice, never found him ruffled. He had limitless patience, understanding, sympathy and intellectual honesty. He seemed to live the legend "to know all is to forgive all".

(*Contd ..*)

He had intense dislike for the rat-race in the service and always felt ill at ease with many of us-lesser mortals— who relished being surrounded by grovelling and saluting subordinates. He hated the system that required beat guards and others lining up the roads along which senior officers like CFs or CCF were to pass, unavoidable though sometimes it was. His was a liberal, philosophical and intellectual temperament and any kind of feudalism and regimentation went against his grain. That was the reason why out of a total of 33 years of his active life he spent a minimal of 18 years with the Forest Department— the rest being devoted to research and teaching in academic institutions.

When we met for the last time about a year ago, amongst other ailments he was greatly exercised over his losing eyesight. His last letter was a detailed one intimating that his fears about his eyesight were unfounded but that he seemed to have problems of heart. He had fallen unconscious once. The messenger of Death appeared to be knocking at his doors, he wrote and added that he was ready to depart anytime he chose to take him. He had completed his arrangements and would leave without regrets. Unconvinced about my own words, I encouraged him as best I could. But he was right. Death's messenger was hovering over him undecided how to put out the gentle flame that still burned. It was 18th of July, 1992 and he was travelling on a train that was to take him from Durgapur to Jhansi. He told his wife that he would like to have a brief nap. How was he or his wife ever to know that the brief nap was to turn into everlasting sleep from which he would awake into a new world and to a new life. Merciful Death! what a gentle way to take away such a gentle soul. No last minute farewells, no wailing and weeping, no "longing lingering look" in the eyes, no tears or travails; only an eternal peace.

Asthana leaves behind a grieving wife, two well-settled engineer sons and a happily married daughter. And he leaves behind too, a large circle of friends who knew him and admired him. And among them is one little man who counted him among his dearest and nearest friends. In writing this piece he is fulfilling his part of the promise he never made when he met his friend for the last time about a year ago.

"Bid me not Good Night (my friend) but in some brighter Clime "Bid me Good Morning".

May his soul find peace and rest.

D.N M.

(II)

Ramesh Chandra Vyas

(1925–1992)

It is with a sense of profound sorrow that we convey the death of Shri Ramesh Chandra Vyas, a retired I.F.S. Officer of the M.P. Cadre, on 18.10.1992. He was 68. He was afflicted with a serious malady, which necessitated several surgeries. Even the best available medical and surgical aids could not arrest this disease and save his life.

After undergoing Forest Rangers Training at Dehra Dun (1944-46) course, he joined the Forest Department of the earstwhile Dhar State as Forest Ranger. By dint of his hard work, understanding and integrity he rose to the post of Conservator of Forests, from which post he retired in March 1983.

Shri Vyas had a very amicable personality. He was always very cheerful and had a smile and a word for every one. This quality endeared him to one and all, colleagues, subordinates, friends and neighbours.

He is survived by his widow, three sons and a host of friends, admirers and relations.

We extend to the members of the bereaved family our heartfelt condolences and pray for the departed soul.

V.M.P.

GAZETTE NOTIFICATIONS

U.P. GAZETTE

The following Indian Forest Service Officers are promoted and posted as under :

		Name of the Officer's and Present Post.	Designation and place of posting.
		1	2
1—	Shri	Chandra Gupta, C.C F., Uttaranchal.	— C C F., Social Forestry, Lucknow.
2—	”	R.S. Singh, C.C.F. (Central), Lucknow	— Managing Director, U.P. Forest Corporation, Lucknow.
3—	”	N.S. Negi, General Manager, U.P. Forest Corporation, Lucknow	— C C.F., (Central), Lucknow.
4—	”	K.C. Thapliyal, C.C.F., (Management), Nainital	— C.C.F., Uttaranchal, Nainital
5—	”	Jawahar Lal, C.C.F., Eastern Circle, Allahabad,	— C.C F., (Management), Nainital.
6 —	”	H.C. Khanduri, Conservator of Forests, Working Plan Circle, Nainital	— C.C.F., Eastern Circle, Allahabad
7—	”	A.M. Rai, Regional Manager, U.P. Forest Corporation, Gorakhpur.	— Conservator of Forests, Faizabad.
8—	”	Brajendra Prasad, Conservator of Forests, Faizabad.	— Project Director, Pauri.
9—	”	R.P. Phulera, Project Director, Pauri.	— Project Director, Almora
10 —	”	S.H.A. Rizvi, Conservator of Forests, Muradabad.	— Conservator of Forests, Kanpur.
11 —	”	B.K.P. Sinha, Conservator of Forest, Kanpur.	— Conservator of Forests, Western Circle, Nainital.
12—	”	Shyam Lal Shilpkar, Conservator of Forests, Western Circle, Nainital.	— Conservator of Forests, Agra.
13—	”	D.N. Bhatt, Conservator of Forests, Agra.	— Conservator of Forests, Working Plan-I.
14 —	”	H.C. Varshney, Conservator of Forests, Working Plan-II.	— Conservator of Forests, Bareilly.
15 —	”	H.C. Johri, Conservator of Forests, Bareilly.	— Conservator of Forests, Muradabad.
16 —	”	K. Prasad, Nodal Officer, Lucknow.	— Regional Manager, U.P. Forest Corporation, Gorakhpur.
17 -	”	Sarat Chandra, Dy. Project Director, Watershed Management.	— Conservator of Forests, Working Plan-II.

(*Contd...*)

		1	2
18—	”	J.S. Asthana, Divisional Director, Kanpur.	— Conservator of Forests, and Nodal Officer, Lucknow.
19—	”	K.N. Singh, Conservator of Forests, World Food Frogramme, Lucknow.	— Conservator of Forests, H.Q., Lucknow.
20—	”	P.C. Agrawal, C.F., H.Q., Lucknow.	— Conservator of Forests, World Food Programme, Lucknow.
21—	”	M.S. Bhupal, Working Plan Officer, Kedarnath.	— Divisional Director, Muzaffar Nagar.
22—	”	S K. Rastogi, Working Plan Officer, Obra.	— Divisional Director, Mainpuri.
23—	”	Ajai Kumar, Asstt to C.C.F., Bareilly.	— D.F.O., Banda.
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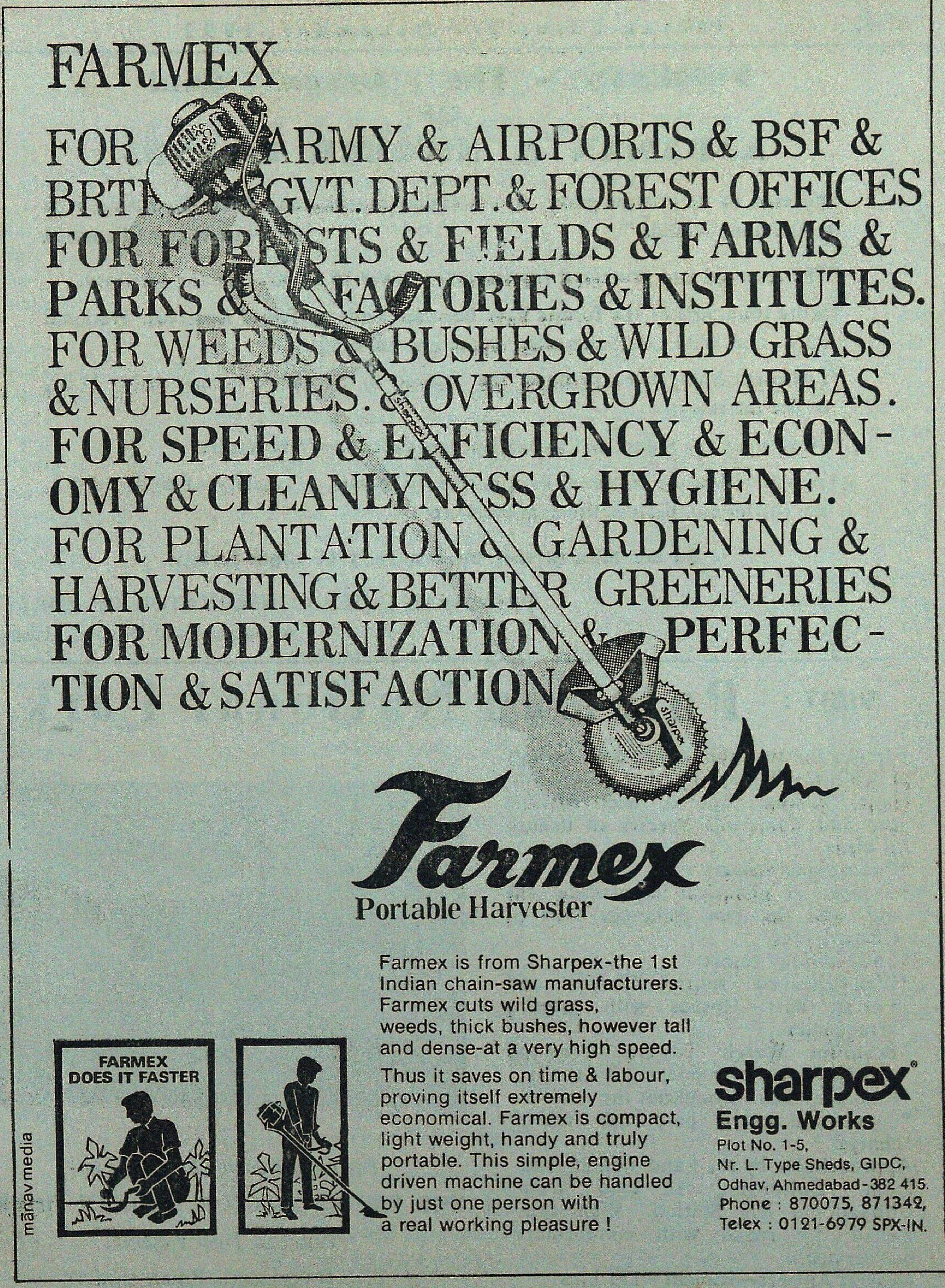

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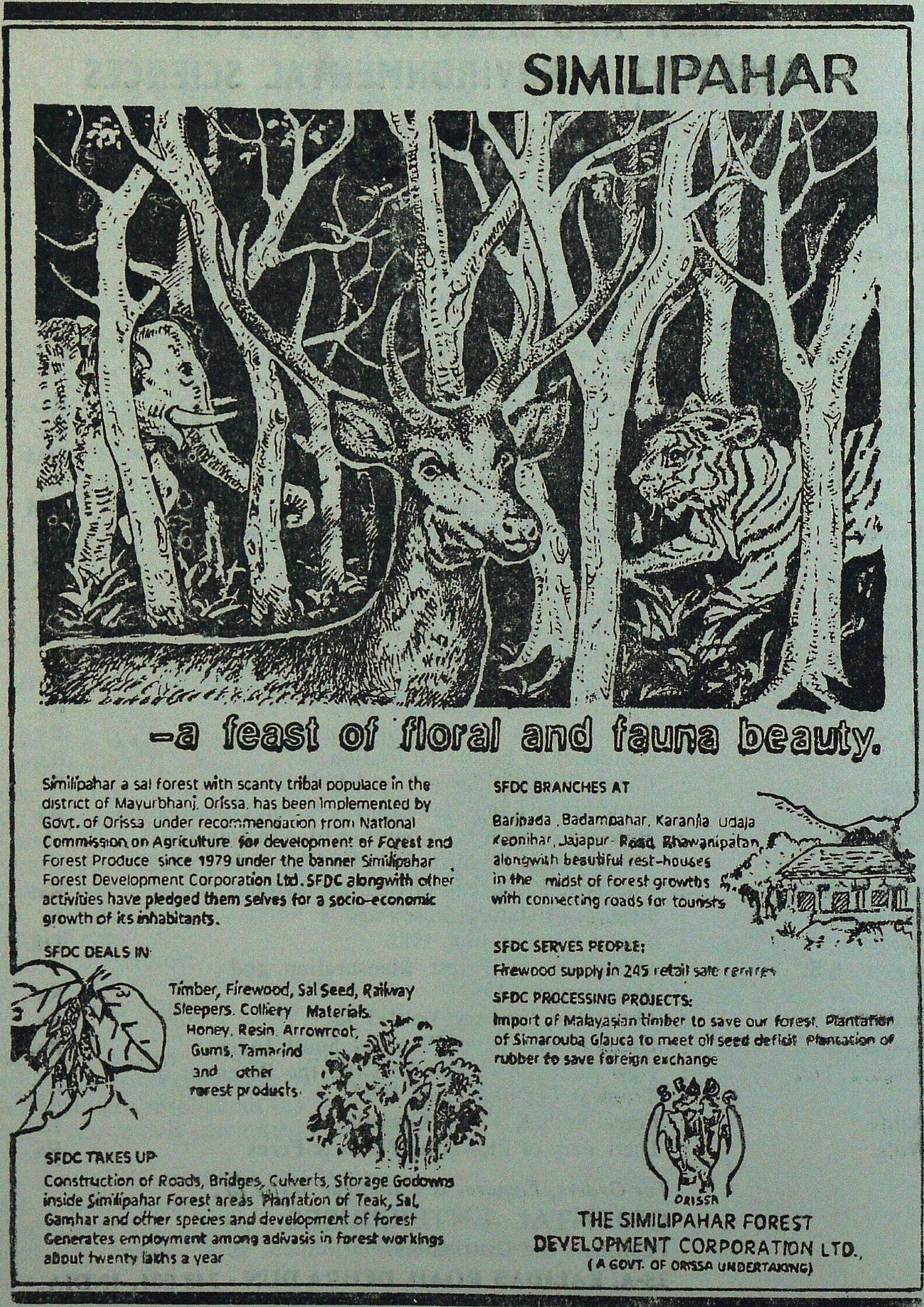

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3,708	हेक्टर क्षेत्र में मिश्रित प्रजाति रोपण
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6,425	लाख पौधों का पर्यावरण सुधार हेतु रोपण

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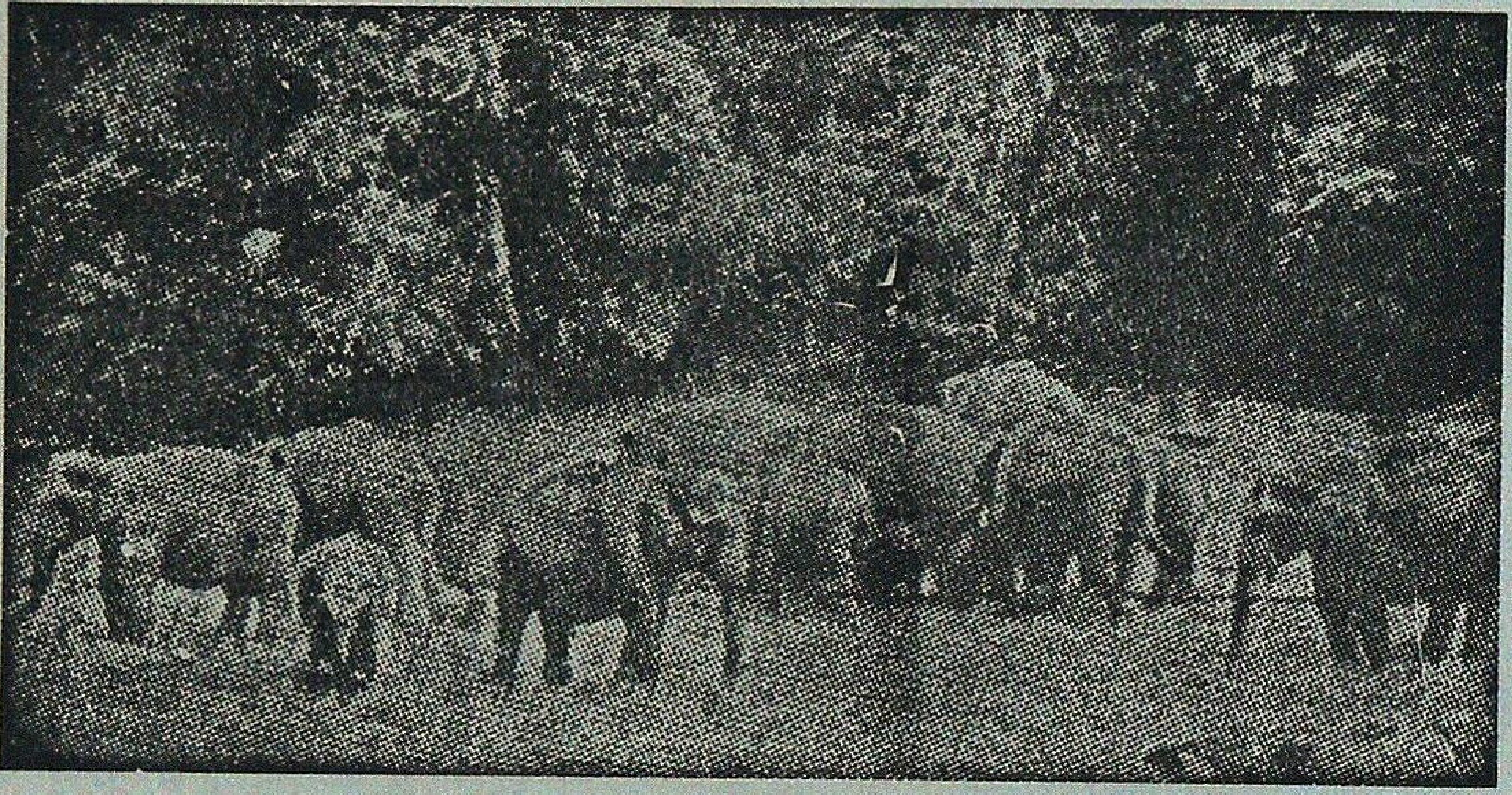

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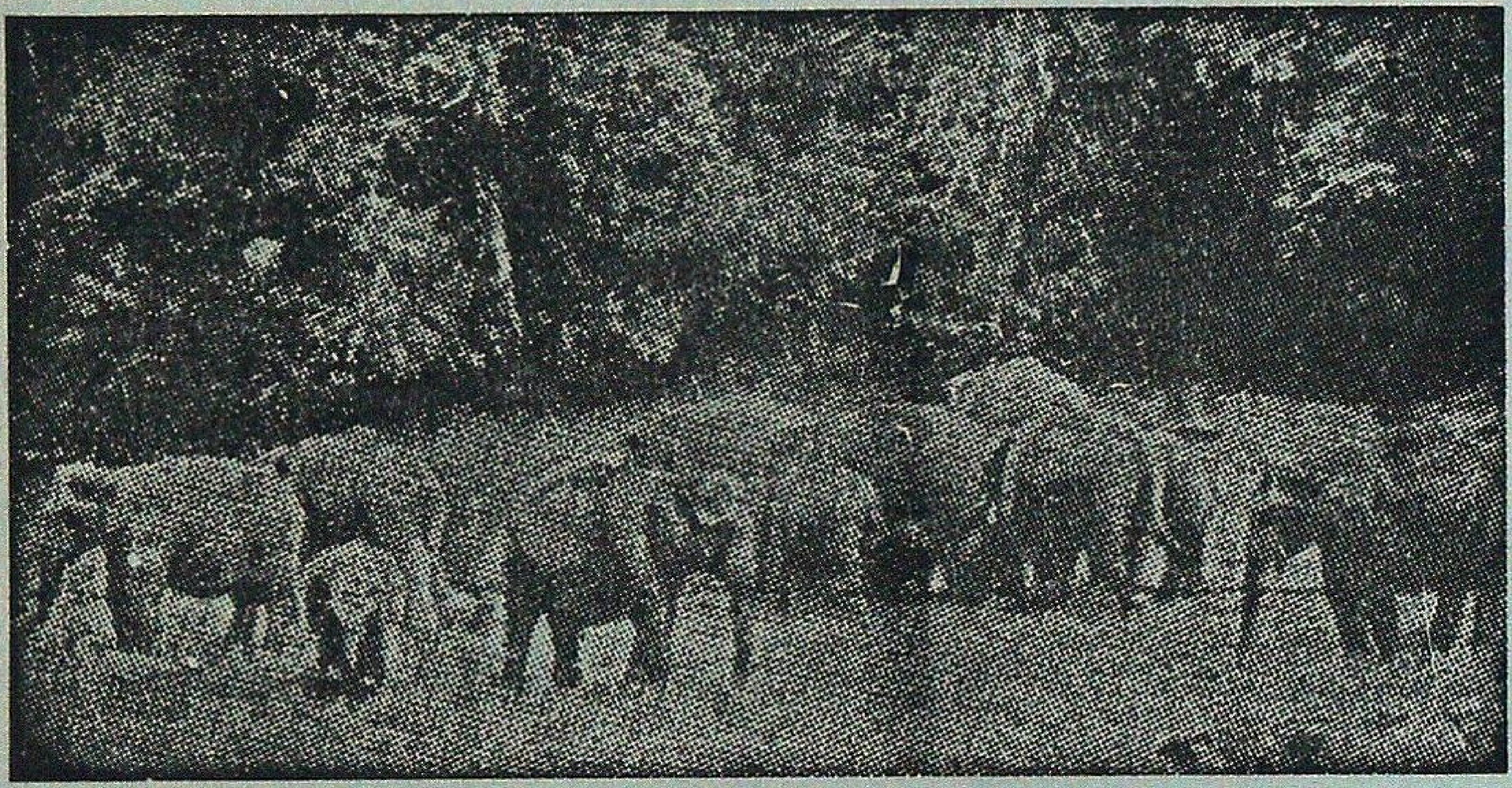

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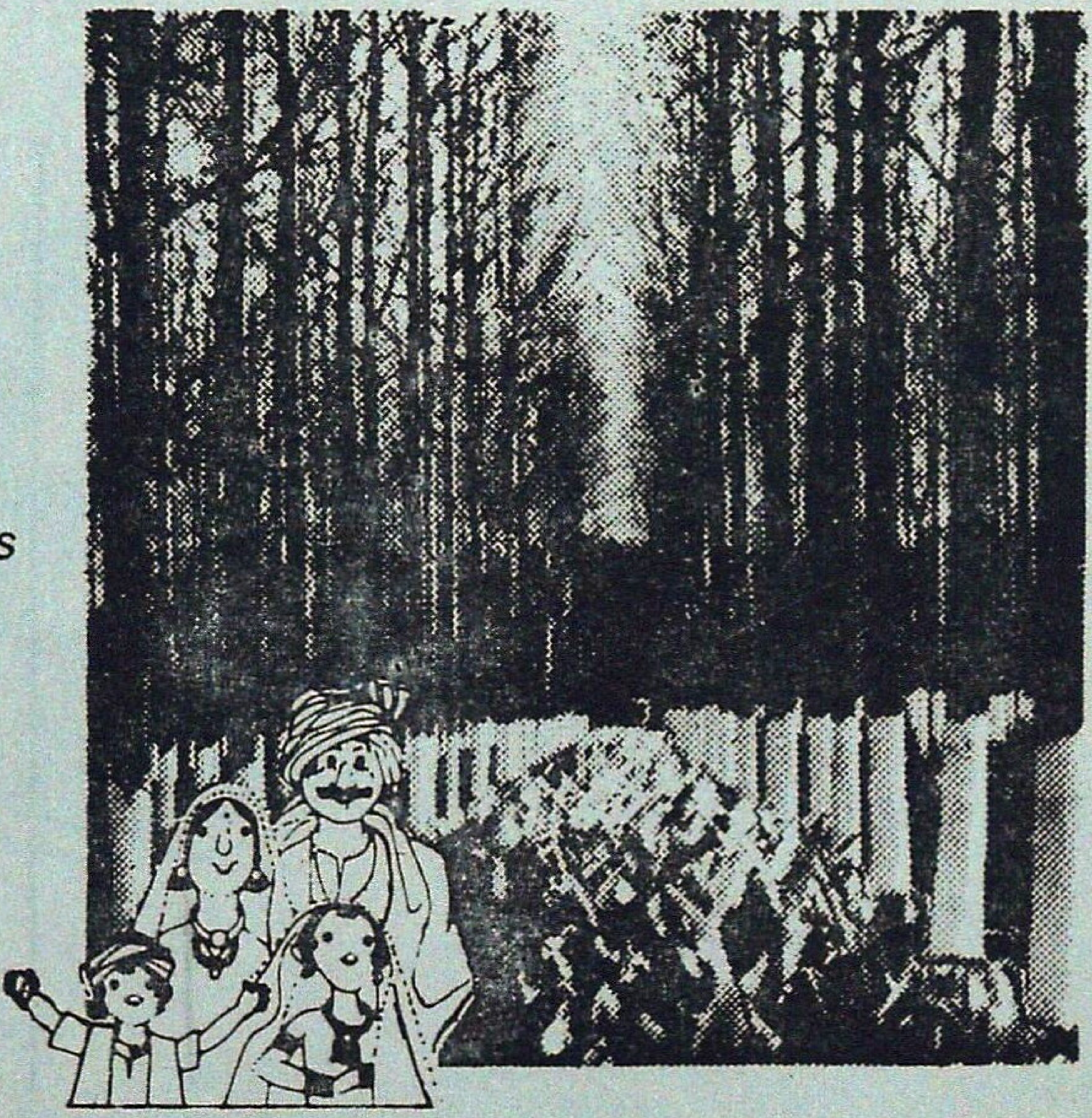

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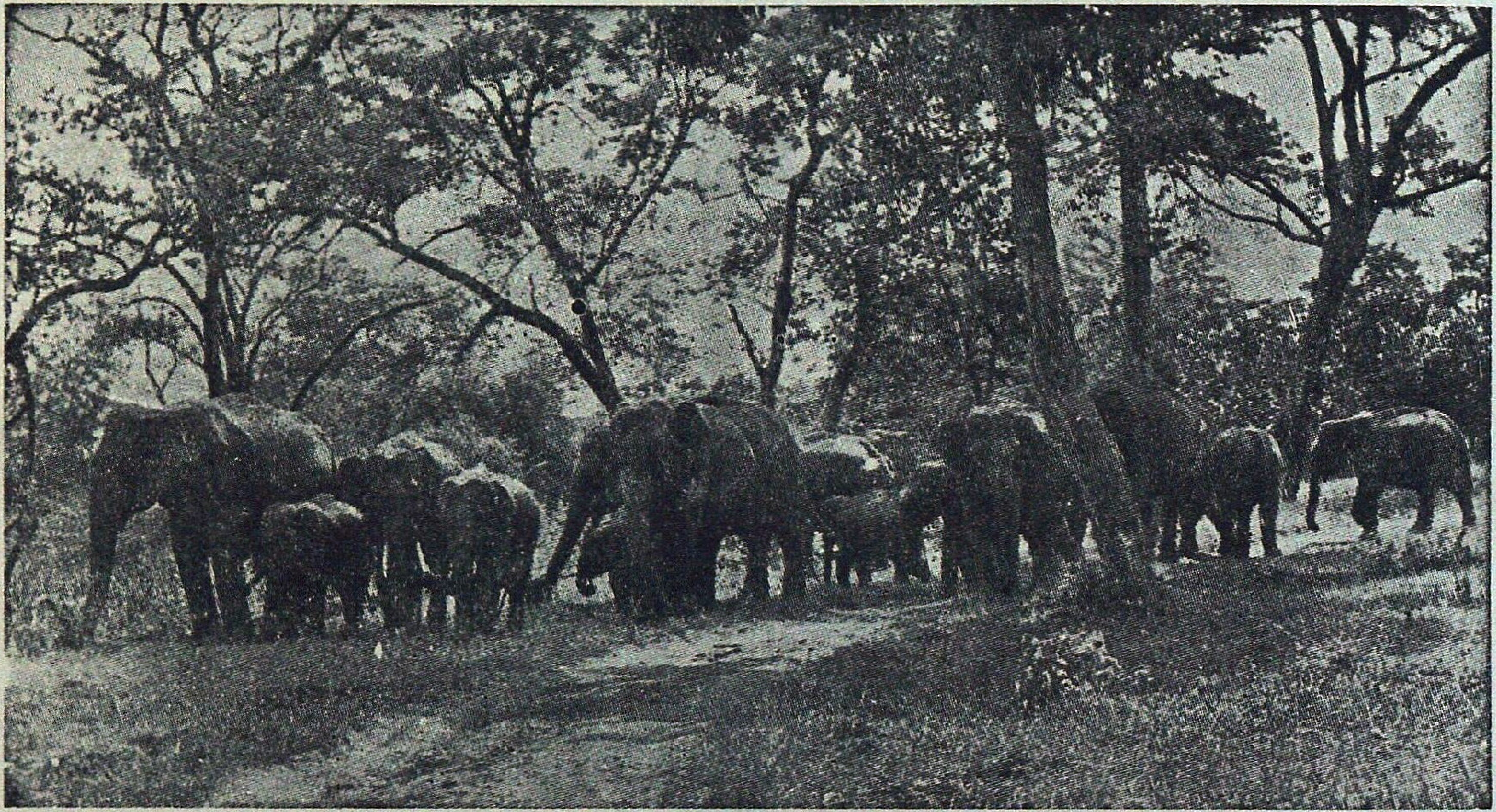

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For further particulars, please contact

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and

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